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WHITE MAN VERSUS THE PRAIRIE[1]

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THE prairie that I have in mind in this essay is that vast sweep of potentially natural grassland that stretches from the ninety-fifth meridian westward to about the one hundred and fifth meridian, and from Canada southward to the Rio Grande and the Gulf. The title suggests something of the nature of a contest in which the advantage may swing now toward one factor, and at another period the other may be favored. We are thus reminded of the ebb and flow of the rhythms that characterize so many of the phenomena of dynamic natural history.

Much of the thrill that helps to compensate the scientist, in his constant search for truth, comes from the contemplation of the natural cycles that appear on every hand. Man himself is a composite rhythm of precariously complex balances, as indeed is the universe as a whole. Life and death are but two of the termini that mark the rhythmic phenomena of the cosmos. As Goethe wrote:

> The spectacle of nature is always new, for she is always renewing the spectators. Life is her most exquisite invention, and death is her expert contrivance to get plenty of it.

During the past century scientists have clearly demonstrated that nature and time had played with inferior organisms of great variety in lapping waters and by muddy shorelines for hundreds of millions of years before man entered the dynamic landscape. Many of those early creatures had already gone the way of all dust because they failed to adjust their fundamental affairs to meet the rhythmic vicissitudes that have characterized the sweep of time. Primitive man, crude as he may have been, was "smart enough"

[1] Address of the retiring vice-president and chairman of the Section on Botanical Sciences, American Association for the Advancement of Science, Columbus, Ohio, December 28, 1939.

to conclude that he was the only true and all-powerful "Lord of Creation" to emerge from the cosmic whorl. It may be significant to note, in passing, that the contributions of those folks and their ilk to intellectual and social advancement have become more completely disarticulated than have their physical bodies. We find only a hunk of a skull, a fragment of the jaw, a single tooth or a few uncertain artifacts embedded in wind-deposited or water-laid sediments with which to construct our notions of them and their day.

Fragmentary evidence appears to indicate that a few wise men of all ages knew quite well how society should plan if man hoped to operate successfully and continuously within the mighty cycles that rule the universe. But it is true that those sages were sadly unsuccessful in their efforts to control the human greed, selfishness and the lust for power that tended to lead the races astray. Disappointment and disillusionment have followed in the wake of man's debauchery and his inheritances throughout the ages. In these latter days that we like to think enlightened, men shudder as they contemplate the wrecks of the past. We are bewildered when we behold the scanty vestiges of the lost civilizations that are uncovered in the sands of China. We are thrilled and then shocked into deepest humility when we stand in the presence of the crumbling palaces and splendid tombs of Egypt and Greece and Rome, now in large part mercifully enshrouded by the silt and sand of time.

Two thousand years ago an unusual farmer boy lived in northern Italy. That young chap was aware of much of the hidden and practical ways of nature, especially those that are close to the land. Virgil recorded many of his observations of natural phenomena in those classics known as the "Georgics." He protested against the senseless waste of natural resources. He sought to teach that there is dignity in labor upon the soil, and that there is strength and happiness to be found in a closeness to nature. He was a mighty good farmer. Listen, for instance, to a bit of his advice regarding the utilization of land as it is told in the first "Georgic":

> But ere we stir the unbroken ground,
> The various course of seasons must be found;
> The weather and the setting of the winds—
> The culture suiting to the several kinds
> of seeds and plants, and what will thrive and rise,
> And what the genius of the soil denies.

The ancients did not follow the urge of the early men of vision in the sensible utilization of the natural bounties so richly bestowed upon them. Fragmentary mementos of worn-out and buried civilizations have marked those lands for centuries. The Incas and the Mayas have vanished. A few wind-strewn relics on a mountainside and the wrecked piles of magnificent temples in a tropical jungle are intriguing evidences of their fundamental blunders.

Viewed against the background of human history, or the more spacious landscape that portrays the interlocked rhythms of the natural history of Mother Earth, it is only this morning that the *Mayflower* docked in Plymouth Bay—only last night that the foundations of Jamestown were laid. The colonies could vision faintly, if at all, the incredible treasure of forest and prairie, of wild life, of clear streams and spacious skies that spread ever westward. It was quite proper for them to fell the pines and spruces, the sturdy oaks and elms, to build their homes, and fashion the ships with which they won their freedom. Land must be cleared of forest, and grassy intervals must be plowed to care for expanding settlements.

That was all as it should have been. No one will take issue with the colonists, or with any person or group since those stirring days, in their efforts to utilize the wealth of the primeval resources of America. It is against the lack of thrift and the ruthlessness and waste which have marked such activities that we must complain. Notable warnings were raised from time to time by various early patriots (as of old). The good advice of Penn and Washington went unheeded. Jefferson pointed out that "fields are no sooner cleared than washed." Patrick Henry warned that "since the achievement of our independence, he is the greatest patriot who stops the most gullies."

Long before the American colonists made their first clearings Virgil foretold (in the second "Georgic") the devastation, destruction and doom, which haunt even dumb beasts, that regularly follow the thoughtless, selfish efforts of man in the exploitation of a nation's wild resources. Listen to the words of wisdom from that ecological farmer of the first century B.C.:

> The like of forest land is understood
> From which the spleeful Ploughman grubs the wood,
> Which had for length of ages idle stood.
> The birds forsake the Ruines of their seat,
> And, flying from their nests, their callow young forgot,
> The coarse, lean Gravel on the mountain sides,
> Scarce dewey Bev'rage for bees provides. . . .
> . . . Happy the man, who studying Nature's laws
> Thro known Effects can trace the Ancient Cause.

As a nation and as individuals we have blundered, like the vanished races of earth, in the utilization of our primitive wild-life resources. We have been little concerned about the balances of nature which, if severely disturbed, may bring disaster to large blocks of society. We have boasted too much of our inexhaustible supplies of earth's native goods, and of a growing mastery that gave us every right to *win* in the conquest *against* nature and time. This situation has, of course, become widely known, especially in so

far as the forest is involved. The axe and the saw and the forest fire played their parts in the disturbance of the balance of one of our major biological swings. An aftermath of worthless brambles, blackened ghosts and gullied slopes mocks us from millions of acres where once nature perfected the amazing forest. The nation is just now learning that white man has also continued to function as the blatant beast of the wasted prairies. It is pitiful to what extent enlightened society has sounded the discordant note in this wild American symphony—a composition that one hears best in the shadowy aisles of the virgin forest or on the broad sweep of the open prairie at sunset.

A hundred years ago the population pressure of the forested lands in the east turned white man's face toward the western prairies. The new migration was dominated by the same restless, romantic, ruthless spirit that had characterized the earlier pioneers. Long after the colorful decades of the colonial period white man spread toward and over the far-flung land of gentle grassy knolls, ravines and sweeping plains with the same all-engulfing enthusiasm with which he had breezed through the forests of the earlier day. The contest of white man versus the prairie was on.

The rolling expanse of virgin prairie, a thousand miles wide, was indeed a formidable barrier to the westward march of settlement. Only men with the reckless spirit that developed the 6-shooter or those driven by an overwhelming religious zeal, such as the Morman pioneers, dared risk the terrors of the long trek into or across that uncertain belt of grassland. The effort was richly charged with adventure and often spiced with romance. We still enjoy the colorful tales that tend to portray the exhilarating but precarious life of the pioneers of the prairies.

In picturesque vehicles and with characteristic impedimenta their caravans snaked across the wild ravines of waving grasses and flat plains of kinky sod to the foothills of the Rockies. They thronged to the battle on a thousand fronts. Uncounted divisions enlisted to win the virgin richness of the prairie from Mother Nature, and to turn her treasures to the creation of another huge "empire" of "man's own making." Cattlemen followed the trappers and the frontiersmen. Farmers hurried westward in the wake of the herdsmen. Bison and Red Men fell by the wayside. Crawling caravans of settlers from the East flocked into the land of meadow larks and Andropogons. We told the world about the golden riches that were hidden in the loamy soils of the prairie. A little later the iron horse reared up the ravines and over the divides, ever westward, to relieve the winding trails and the dusty ruts of the prairie schooners. The deer, the antelope, the prairie chicken and the bob-white went the way of the buffalo and the Indian. Along with the settlers came trees, feathered creatures and sophisticated crops, the like of which the prairie had never known.

As a small boy on a Nebraska farm, toward the close of that fascinating period, we were thrilled with the spirit of the times. Many the bleak wintry nights that we dreamt of the cunning schemes of a Red Cloud and the last desperate thrusts of a Sitting Bull. The very air was electrified with primitive human activities. We labored in our childish way to help to pay off one mortgage, only to inherit a larger one. Life was full, and the fine wild things of nature were close, so varied, so abundant. The rich odor of freshly turned soil, the fragrance of the wild plum blooms and prairie roses were not yet contaminated by highway aldehydes, creosotes, packing-house stinks and what have you!

We shared personally, to a small degree, in the breaking of those prairie sods, from which states have grown. The trim, low plow with its gracefully turned mouldboard and the long, sharp lay, the sturdy mules forward and the stalwart boy aft, was a common institution of the prairies in those days. The keen, diagonal blade of the breaking plow scored a snipping symphony with the roots and rhizomes of the prairie grasses and their associates. Those plants were the children of species which nature had been perfecting on those soils since Tertiary times! The long, tough spirals of sod flowed backward from the glistening plowshare in an unbroken band, and settled, upside down as a continuous, plank-like record of man's conquering (?) march.

Then came the selfbinder, the riding gang-plow, the tractor, and with those instruments, the urge for more acres (and more mortgages). Great carpets of tall prairie grasses and kinky short grasses were turned on an ever-widening front to the westward. An abundance of moisture at the time, and practically free land, stimulated a rapidly extending settlement and intensified the efforts to reap the rich harvests from the newly acquired dominion on the "lone prairie."

White man took the prairie too blithely, as earlier he had taken the forest. What he did not appreciate was that, although man may turn the sods and plant the grain and trees, it is only God who sends the raindrops. Man failed to envision the prairie as one of earth's astounding examples of an infinitely complicated biological rhythm that had been evolving in that domain since the Tertiary. He was slow in learning that the virginity of the prairie had been established through long ages of travail and that the wild things that he saw there were an infallible index of what was best, in the long run, for such a place. He failed to sense the danger involved if he dared to cross nature's tenacious tendencies with radical schemes for utilizing the native range and introducing the crops of the humid East.

Many mistakes were made, but, in general, all went

well for years or at least periodically. Came sizzling summers and frigid winters, that alternately seared the bodies and froze the souls of those hardy men. Thousands of them fled. After periods of indescribable misery, the rains came again, the "climate changed" and another boom was on. The survivors trustingly enclosed their home grounds and fields with belts of cottonwoods, ashes, bois d'arc and maples. More cattle and more sheep spread over the treeless range-lands that seemingly flowed to the setting sun. More sod was turned, more crops sown.

And so it continued from cycle to cycle. In spite of severe chastisement by the recurring biological upsets, the prairies continued to evolve new barons of meat and wheat. The all-conquering lords became more and more megacephalic and ventricose gibbous. They had just about completed the conquest of man against nature throughout the rolling horizons of the American prairies when, in 1933, Mother Nature once more, and quite suddenly, appeared to play her long-accustomed part in another roundup. Men had not yet understood how treacherously narrow was the margin of safety within which they had practiced their arts in "conquering" the prairies. Nature began once more to number the raindrops. There were not enough of them for the thirsty fields of maize and wheat that man had placed where once were species whose conditioning dated from an earlier age. Succeeding crops were pitifully poor. Failure was common. Trees from the humid forest bowed their leafy heads, gave up the struggle. Their decorticated trunks stand as ghostly reminders of man's folly. Even the hardy prairie grasses and the ubiquitous ruderals that had crept into openings in the prairie sod were badly weakened or completely obliterated. The cattle and sheep in sunny dells and on a thousand breezy hills nibbled the dwindling grasses and upstart weeds. Cloven hoofs and sweeping blasts of earth dissected the last surviving crowns and added their mangled forms to the swirling, black clouds that were swept up from the precious top-soil. Fallow fields of powdery soil had replaced the flowing grain, the lush pasture and the grassy range.

The reactions from white man's incisive invasion of the prairie had so disturbed the long-established and well-ordered rhythms in the good earth that the fingers of nature caught up the soil and flung it at the sky. Indeed it could then be said:

> The hills were shadows, and they flow
> From form to form, and nothing stands;
> They melt like mists, the solid lands,
> Like clouds they shape themselves and go.

On and on whirled the choking dust in a widening cloud, a veritable black blizzard that blotted out the light of day and buried white man and his eroded trappings under the stifling pall. The atmosphere was laden with millions of tons of the choicest surface soils. The dust swept onward, ever eastward, until it settled upon the White House and was gathered into the humid oblivion of the Atlantic. The latter day storms of vaporous earth must, indeed, reflect something of the cosmic magnitude and severity that marked the period of loessial deposits.

Bad as the situation has been, as related to wind erosion, there are other severe aspects of White Man's insistence upon conquering the prairie. We may refer to the wide-spread destruction of land and other property, and the loss of hundreds of lives caused by floods in various parts of the nation, including the prairies. We are impressed by the sincerity of purpose and the vigor of the interests that investigate such calamities and endeavor to find means to forestall their recurrence. In the most of these efforts it is somewhat disconcerting, however, to note the scanty attention that has been given, until lately, to the biological conditions far back on the various watersheds that contribute to the inception of floods and dust storms.

Tremendous losses were suffered in southwestern Nebraska in the early summer of 1935 because of flood waters that swept through the Republican River section of the prairies. Since that time the area has been the focus of considerable attention, not only as looking toward the prevention of further damage by water, but because of the period of severe drought, toward the possibility of impounding the waters of the stream for irrigation. In all this agitation little concern has as yet been expressed for certain significant features of the ecological set-up that prevailed (and still prevails) on the upstream slopes of the river for many years preceding the devastating flood of 1935.

For a long time white man had been an active party (more or less unintentionally) to the crippling and ruination of the wild prairie that stretched over the drainage area of that stream. Years ago we noted the progress of those modifications of the rhythms of the prairie which contributed in no small degree to the development of conditions that culminated in that disaster. The prairie sod had been severely disturbed over wide expanses by breaking, overgrazing, fire and possibly by earlier droughts. Even in districts where the sod had not been turned by the plow, there were then huge stretches of land that were dominated by pepper grass, sunflowers and other hardy weeds. The plant population had been severely reduced in density and virility and the soil was essentially bare in many places on the uplands of the Republican watershed.

There was little upon the face of the earth in that area to shield the powdery soil from the initial attacks of the falling torrents of rain that began late in May,

1935. The surface of the soil was so dry and fine that the drops could not force themselves into it. Rivulets of brown water rapidly grew in volume as they sped to the lower contours. Soon, under continued precipitation, the gully-washer stage was reached. From boiling gullies to raging, relentless flood water was but a moment in the story. The mighty force of the once precious, but now treacherous liquid uprooted trees, displaced bridges and buildings, inundated farms, flooded cities and spread the hush of death over the valley. From a genesis so simple and unimpressive on the upstream flats and gentle slopes the water was rapidly transformed into a destroying demon that left terror along its route.

But, you ask, what is white man to do about it?

First of all, we must learn that Mother Nature is not a nudist by choice. If left to her own ways, she will clothe herself in a lovely smock of forest trees, or at least in a sarong of prairie grasses or weeds. I have been intimating that man, for thousands of years, has been running away with her clothes so persistently and so completely that she has had the greatest of difficulty to preserve her modesty.

Perhaps the egocentric complex that has for so long time dominated White Man in his attitudes toward nature and her primitive ways has finally felt the impact of such shocking experiences that we, in America, may pave the way for better times. It would seem, in spite of the blotted and grimy picture of the past, that such an opportunity is still open to us. Certainly, if we do not mend our ways, we shall witness the continued spread of frightful ugliness over the land.

There are, at last, hopeful signs that progress is to be made toward the formulation of a more enlightened program to guide our ambitions in the future. Numerous well-endowed institutions and individuals are turning their best abilities toward such efforts. To aid in the discovery and clarification of what may be done to preserve such balances among the major natural rhythms that the perpetuation and continued improvement of nature's abundant bounties may be insured, is certainly an objective that is as rich in spiritual returns as it is bristling with the challenge to science.

Reputable biologists do not claim that the maintenance of a cover of forest trees or prairie grasses or fully cropped fields on the upstream slopes and over vast sweeps of prairies and forests will prevent floods and dust storms at all times and under all conditions. We must admit that man is helpless to tame the rain clouds and the continental winds or to build the rocks and renew the hills. We boast of impressive works in the form of dams, levees and revetments that tend to protect against the flood waters. Seldom, however, do we pause to analyze the primitive biological phenomena that are commonly associated with the earlier droplets of water or whisks of dust that gather over the denuded ridges and slopes or fallow fields far back from the raging flood and the settling dust. Perhaps if we insisted upon a saner plan of settlement and utilization, the expenditure of modest sums would be sufficient to accommodate those first little units of water and earth, from which the flood and the dust bowl may develop.

It is fine, of course, for the engineer to lay obstacles across the path of the flood, but most such works are designed primarily to care for the flood waters when they arrive down stream. I would plead for more interest in the ecological relationships of the outer areas of the watershed where erosion really begins and over which waters and winds may gain their destructive volume and momentum. If White Man would maintain and improve the natural means of absorbing the raindrops where they fall and hold them in the woodlands, the prairies and the fields where they are so sorely needed, their rapid and destructive coalescence might be prevented or so greatly reduced that floods and dust storms would not menace him. It would seem that a good place to begin the study of erosion is the place where erosion begins.

White Man may exert great influence in the steady maintenance of a cover of vegetation on the land. He may plant and he may sow, and he may aid Nature in such a manner as to improve the complicated biological character of the soil. Students in my own department have proved (in a modest way) that even a scanty cover of plants profoundly increases the absorption of falling water, and at the same time greatly reduces the volume of water that drains from the land. A few grasses or even a light cover of cultivated plants soften the blows of the falling raindrops and surprisingly reduce the amount of suspended and dissolved material that is moved from the land by water. Runoff on a 5° slope, from 12.9 inches of rain that fell in eleven months was 1 per cent. from the prairie, 12.1 per cent. from a wheat field and 17.8 per cent. from fallow land. And no measurable erosion occurred from the prairie, while 0.52 tons of soil per acre was carried from the wheat field, and 2.6 tons from the fallow area. Runoff resulting from the fall of 3 inches of rain in 1.5 hours on a 7° slope was nil from prairie, but 20 per cent. from broken prairie planted to corn for six years. Such differences holding over a large catchment basin might readily represent the difference between severe floods and no flood at all. It has also been demonstrated that the tangle of rhizomes and roots of prairie grasses that permeate the soil to many feet beneath the surface serves as a mighty obstacle in the way of soil dissection by the erosive force of water and wind. The maintenance of some such barriers throughout the nation's forests, prairies and fields would seem to be imperative when

we are told that water and wind remove not less than 3 billion tons of soil from our croplands and associated pastures alone every year.

But I am not to tire you with the quotation of statistics or the recital of experimental data and conclusions. I would merely insist that White Man should cease to boast of having *conquered* nature. That is an important lesson that we should sense from the severe and recurring demonstrations that continue to prostrate mankind. Certainly the advantage in the contest of White Man versus the prairie in North America in the past several years has been with those superhuman forces that made and that tend to preserve the prairies inviolate. One of the major problems that now faces man throughout the world is to preserve what is left of his heritage in the soil, and to restore the broken lands that have dogged his footsteps through the forests and across the prairies for centuries.

VITAMIN K

By Drs. E. A. DOISY, S. B. BINKLEY, S. A. THAYER and R. W. McKEE

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DURING the course of some experiments on the sterol metabolism of the chicken, Dam[1] (1929) observed that chicks raised on certain artificial diets became anemic, had large subcutaneous and intramuscular hemorrhages and that in one chick the clotting time of the blood was markedly increased. This striking hemorrhagic condition and prolonged clotting time were also observed by McFarlane,[2] *et al.* Although Holst and Halbrook[3] did not mention the impairment of coagulation, they observed the hemorrhages and reported their disappearance after the addition of fresh cabbage to the diet.

Continuing his work Dam[4] reported that the hemorrhagic condition was not relieved by the addition to the diet of vitamin C or any other of the known vitamins or essential dietary factors. He suggested that the hemorrhages and prolonged coagulation time were due to the lack of a new fat-soluble factor, which he named "vitamin K," from the Scandinavian and German term "Koagulations-Vitamin." This terminology has been accepted by other investigators in the field, but with the isolation of two compounds possessing vitamin K activity subscripts were added to K for purposes of designation.

Beginning in 1935, many important reports on the distribution, extraction, assay and chemistry of vitamin K have been published by Dam and his collaborators and by Almquist and his group of investigators. It is unfortunate that space limitations prevent us from referring to several of these publications.[5]

[1] Dam, *Biochem. Zt.*, 215: 475, 1929; 220: 158, 1930.

[2] McFarlane, Graham and Richardson, *Biochem. Jour.*, 25: 358, 1931.

[3] Holst and Halbrook, SCIENCE, 77: 354, 1933.

[4] Dam and Schønheyder, *Biochem. Jour.*, 28: 1355, 1934.

[5] Since the main purpose of this report is to set forth the present status of the vitamin K problem, an extensive review of the subject has not been attempted. The experimental work has been reviewed by Dam (*Ztschr. f. Vitaminforschung*, 8: 248, 1938–39) and clinical work by Smith, *et al.* (*Jour. Am. Med. Assn.*, 113: 380, 1939) and Butt, Snell and Osterberg (*Jour. Am. Med. Assn.*, 113: 383, 1939).

SOURCES OF VITAMIN K

Dam[6] and coworkers showed that the antihemorrhagic factor is widely distributed in green leaves and vegetables with an abundance in dried chestnut, spinach, cabbage and alfalfa leaves. Almquist and Stokstad[7] reported in 1935 that the addition of 0.5 per cent. of dry alfalfa to the deficient diet prevented the appearance of symptoms, and from that time alfalfa has been one of the main sources of the vitamin. Recognition of a different antihemorrhagic factor resulted from the observation of Almquist and Stokstad that rice bran, fish meal and other foods which had been stored in a moist condition developed vitamin K activity. That this production was due to the action of micro-organisms was definitely concluded from Osterberg's[8] work, which showed that large amounts of an antihemorrhagic substance were produced by bacterial putrefaction of fish meal, and from the report (Almquist, Pentler and Mecchi[9]) that a large number of different bacteria, including *B. coli*, were able to synthesize a substance having vitamin K activity.

BIOASSAY

Since progress in the vitamin or hormone field is dependent upon the detection and quantitative measurement of the active principle, several groups of investigators, Dam, Schønheyder, Almquist, Ansbacher and Thayer,[10] have devised bioassay procedures for

[6] Dam, *Biochem. J.*, 29: 1273, 1935; Dam and Schønheyder, *Biochem. Jour.*, 30: 897, 1936; Dam and Glavind, *Biochem. Jour.*, 32: 485, 1938.

[7] Almquist and Stokstad, *Nature*, 136: 31, 1935; *Jour. Biol. Chem.*, 111: 105, 1935.

[8] Osterberg, *Proc. Staff Meetings Mayo Clinic*, 13: 72, 1938.

[9] Almquist, Pentler and Mecchi, *Proc. Soc. Exp. Biol. and Med.*, 38: 336, 1938.

[10] Dam and Glavind, *Biochem. Jour.*, 32: 1018, 1938; Schønheyder, *Biochem. Jour.*, 30: 890, 1936; Almquist and Stokstad, *Jour. Nutrition*, 14: 235, 1937; Almquist and Klose, *Biochem. Jour.*, 33: 1055, 1939; Ansbacher, *Jour. Nutrition*, 17: 303, 1939; Thayer, McKee, Binkley,

vitamin K. In general, the procedures are either curative or preventive; in the former the deficiency is produced by maintaining young chicks on a diet devoid of vitamin K. After the deficiency has been produced in a severe form, the substance to be tested is administered and after a definite time interval a sample of blood taken for the determination of clotting time. In normal chicks the clotting time is less than three or four minutes, in chicks with a severe degree of deficiency over two or three hours. In these deficient chicks treated with the proper quantity of vitamin K, the clotting time is restored to a normal value within a period of six hours.

The development of quantitative biological methods of assay has enabled investigators to ascertain the most concentrated sources of vitamin K, and to study procedures designed to separate the vitamin in pure form from the natural sources.

Isolation of Vitamin K

The earlier work on the purification of vitamin K was conducted by Dam and by Almquist;[11] a number of interesting points were contributed by each. It was found that the vitamin is insoluble in water and methyl alcohol but soluble in many of the common organic solvents. Both acetone and petroleum ether proved to be satisfactory for the extraction of the vitamin from natural sources. One property, namely, thermostability, has proved to be quite important, since it led Almquist[12] to introduce molecular distillation for the purpose of purification.

The extraction of dried alfalfa leaf meal with petroleum ether gave a green solution which upon concentration resembled green axle grease. Fractionation with solvents proved ineffective in the separation of the pure vitamin. Likewise, chemical reactions on the crude product accomplished little, except to show that certain common procedures could not be employed, *e.g.*, saponification proved useless because of the lability of the vitamin toward alkali.

Two important discoveries had a direct bearing on the isolation of vitamin K. Almquist[13] reported on the lability in alkaline solutions. In our laboratory this report was corroborated and in fact the vitamin proved so sensitive toward alkali that great care was observed always to keep solutions acidic; this was usually accomplished by the addition of glacial acetic acid.

Another important point, also contributed by Almquist,[13] was the discovery of the destruction of the vitamin by ultra-violet light. This caused us[14] to study the effect of sunlight and illumination from ordinary Mazda light bulbs. Since it was found that the latter destroyed the potency of the vitamin, precautions were taken to limit as much as possible the exposure to light. It seems probable that the isolation could not have been accomplished had not the lability toward light and alkali been recognized.

Since the purification of vitamin K was beset with so many difficulties, investigators turned to the possibility of chromatographic adsorption. Both Dam and Almquist used adsorbents, but the only complete detailed descriptions of chromatographic adsorption are found in reports by McKee and Binkley.[15] Since the procedures devised by Binkley, Thayer, MacCorquodale and Doisy led to the isolation[16] of vitamin K they will be discussed in some detail. Although many adsorbents were studied the most satisfactory in our experience are Permutit and Decalso—two artificial zeolites used in certain procedures of water-softening—and a decolorizing carbon Darco.

Vertical glass columns fitted with perforated porcelain bottoms, which were covered with cotton, were used as suitable containers for the adsorbents. The antihemorrhagic factor obtained by the extraction of alfalfa or putrefied fish meal with petroleum ether was adsorbed by passing the petroleum ether extract through the adsorbent. It was eluted by washing successively with 1:10, 1:7 and 1:5 mixtures of benzene and petroleum ether. By using proper solvents for the selective elution of the vitamin, by constantly observing the movement of the colored layers in the column and by careful fractionation of the solvents which percolate through, a high degree of purification can be obtained. Three or four repetitions of this adsorption process, using only the most potent fractions, gave a product of high potency. Putrefied fish meal extracts yielded a reddish yellow oil which crystallized on standing at −5° C.; after recrystallizing several times from an acetone-ethyl alcohol mixture or from a 1:1 mixture of methyl alcohol and chloroform, a pure yellow crystalline compound melting at 53.5–54.5° was obtained. This compound had a potency of approximately 660 units per mg.

MacCorquodale and Doisy, *Proc. Soc. Exp. Biol. and Med.*, 40: 478, 1939; 41: 194, 1939.

[11] Dam and Schønheyder, *Biochem. Jour.*, 30: 897, 1936; Dam and Lewis, *Biochem. Jour.*, 31: 17, 1937; Almquist, *Jour. Biol. Chem.*, 114: 241, 1936; 115: 589, 1936.

[12] Almquist, *Jour. Biol. Chem.*, 120; 635, 1937.

[13] Almquist, *Jour. Biol. Chem.*, 117: 517, 1937.

[14] MacCorquodale, Binkley, McKee, Thayer and Doisy, *Proc. Soc. Exp. Biol. and Med.*, 40: 482, 1939.

[15] McKee, Binkley, Thayer, MacCorquodale and Doisy, *Jour. Biol. Chem.*, 131: 327, 1939; Binkley, MacCorquodale, Thayer and Doisy, *Jour. Biol. Chem.*, 130: 219, 1939.

[16] Dam, Karrer *et al.* (*Helv. Chim. Acta*, 22: 310, 945, 1939) have reported the isolation of vitamin K from alfalfa by a procedure which has not yet been described, but on the basis of the extinction coefficient given by them and the value obtained by Professor Ewing (*Jour. Biol. Chem.*, November, 1939) for our product, it seems likely that the product originally described by them was not pure.

The petroleum ether extracts of dehydrated alfalfa leaves, after a similar series of adsorptions, gave a reddish oil which would not crystallize at $-5°$ C. Further purification by molecular distillation or adsorption on "darco" followed by fractional elution and several recrystallizations from acetone and alcohol at a low temperature ($-60°$ C.) were necessary to obtain a pure product consisting of rosettes of yellow crystals. This compound melted at approximately $-20°$ C. and had a potency of about 1,000 units per mg.

Since it was obvious that the compounds isolated from alfalfa and putrefied fish meal were different, they were named "vitamin K_1" and "vitamin K_2,"[17] respectively.

In order to establish definite proof of the isolation of these two compounds, a derivative[18] of each, the diacetate of the reduced quinone, was prepared by reductive acetylation and the products purified by repeated crystallizations from methyl and ethyl alcohol and analyzed. One of these diacetates, the diacetate of dihydrovitamin K_1, was subsequently hydrolyzed by the Grignard reaction, giving a product identical in every way with the original vitamin K_1.

Constitution

Although it was not possible from the analyses and molecular weight determinations to decide between several alternative formulas it seemed likely that the empirical formula of vitamin K_1[19] was $C_{31}H_{46}O_2$ and vitamin K_2 was $C_{40}H_{54}O_2$.

On catalytic hydrogenation vitamin K_1 absorbed eight atoms of hydrogen giving a colorless compound which on exposure to air was oxidized to a compound possessing the same yellow color as the original vitamin. This oxidation product in turn absorbed 2 atoms of hydrogen, thereby losing its yellow color. Reductive acetylation gave a colorless crystalline compound, m.p. 62–63° having an empirical formula of $C_{35}H_{52}O_4$. Hydrolysis of this compound could not be carried out by common procedures but was effected by means of a Grignard reaction. Oxidation by air then converted the hydroquinone to vitamin K_1. These reactions as well as ultra-violet absorption indicated that the vitamin was quinonoid in nature. Since all 1,2-quinones are red and 1,4-quinones are yellow, it seemed that the vitamin was probably a 1,4-quinone. Comparison of the ultra-violet absorption of the vitamin with the absorption of synthetic 1,4-naphthoquinones, particularly those substituted in the 2 and 3 positions, indicated clearly that the vitamin was a 2,3 disubstituted 1,4-naphthoquinone. This conclusion was consistent with the result of the hydrogenation experiment, since six atoms are required by the quinone ring structure and bromination showed the presence of a double bond in the side chain which accounts for the absorption of the other two atoms of hydrogen.

Oxidation[20] of the vitamin with an excess of chromic acid gave phthalic acid. This observation, taken with our other data, could lead only to the conclusion that the vitamin is a 1,4-naphthoquinone and that the aromatic non-quinonoid ring has no side chains. Since the vitamin gave a negative Craven's reaction, it must be a 2,3-disubstituted 1,4-naphthoquinone.

Mild chromic acid oxidation of the vitamin gave 2-methyl-1,4-naphthoquinone-3-acetic acid. This was confirmed by synthesis of the acid and its methyl ester. Mild chromic acid oxidation of the diacetate of dihydrovitamin K_1 gave 2-methyl-1,4-diacetoxy-naphthalene-3-acetic acid. This acid was converted to 2-methyl-1,4-naphthoquinone-3-acetic acid, which proved to be identical with the acid obtained by direct oxidation of vitamin K_1 and also the synthetic compound.

The expectation that ozonolysis would break the side chain was realized and a ketone $C_{18}H_{36}O$, the semicarbazone of which was identical with the semicarbazone of the ketone obtained from the chromic acid oxidation of phytol,[21] was obtained. A mixed melting point and analyses proved their identity.

From these degradation data it seemed likely that vitamin K_1 is 2-methyl-3-phytyl-1,4-naphthoquinone. That our interpretation was correct was shown by synthesis by the direct condensation of phytol with 1,4-dihydroxy-2-methylnaphthalene in benzene solution using anhydrous zinc chloride as a condensing agent and also by the reaction of the sodium salt of 1,4-dihydroxy-2-methylnaphthalene with phytyl bromide in benzene. The synthetic vitamin was purified in the form of the diacetate, which proved to be identical in melting point, potency and crystalline form with the same compound prepared from the natural vitamin. Moreover, oxidation with chromic acid gave the same products, thereby conclusively proving their identity.

Additional evidence that the structure just given is correct is found in the independent synthesis by different procedures by Almquist[20] and by Fieser.[20] The former reported that he has condensed phytol with 2-methyl-1,4-naphthoquinone and the latter that phytol was condensed wih 1,4-dihydroxy-2-methylnaphthalene in dioxane using oxalic acid as a condensing agent.

[17] McKee, Binkley, MacCorquodale, Thayer and Doisy, *Jour. Am. Chem. Soc.*, 61: 1295, 1939.

[18] Binkley, MacCorquodale, Cheney, Thayer, McKee and Doisy, *Jour. Am. Chem. Soc.*, 61: 1612, 1939.

[19] Binkley, Cheney, Holcomb, McKee, Thayer, MacCorquodale, and Doisy, *J. Am. Chem. Soc.*, 61: 2558, 1939.

[20] MacCorquodale, Cheney, Binkley, Holcomb, McKee, Thayer and Doisy, *Jour. Biol. Chem.*, Nov., 1939; Almquist and Klose, *Jour. Am. Chem. Soc.*, 61: 2557, 1939; *Jour. Biol. Chem.*, 130: 791, 1939; Fieser, *Jour. Am. Chem. Soc.*, 61: 2559, 2561, 1939.

[21] It is interesting to note that phytol is present in green leaves in the chlorophyll molecule and also that the phytyl group occurs in vitamin E.

On catalytic hydrogenation[22] vitamin K_2 absorbs 18 atoms of hydrogen to give a colorless product which on exposure to air oxidizes to a yellow compound. This yellow compound on catalytic reduction absorbs two atoms of hydrogen and becomes colorless. Reductive acetylation of vitamin K_2 also gives a diacetate of the reduced quinone. This diacetyldihydrovitamin K_2 adds 12 atoms of bromine indicating six double bonds in the side chain. The failure of vitamin K_2 to react with maleic anhydride leads to the belief that these bonds are not conjugated. These data, together with the response to Craven's test and the ultra-violet absorption data, indicate that vitamin K_2 is a 2,3 disubstituted 1,4-naphthoquinone having six double bonds in the side chains.

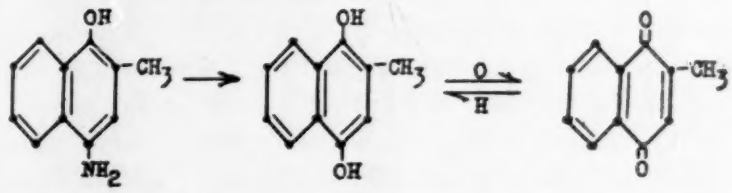
Potencies of Simple 1,4-Naphthoquinones and Related Products

As soon as chemical reactions and degradation results showed vitamin K to be a quinone, the investigation of the simple 1,4-naphthoquinones was begun, and it was promptly found that several possessed vitamin K activity. Since a number of different laboratories became interested in the potencies of the naphthoquinones, the combined results represent a fairly extensive survey. The first report was by Almquist,[23] who apparently correlated the production of vitamin K potency by bacteria with Anderson's phthiocol (3-hydroxy-2-methyl-1,4-naphthoquinone) from tubercle bacilli. This compound possesses potency, but the activity is not comparable with that of the vitamin from alfalfa. Later, it was shown (Ansbacher and Fernholz) that 2-methyl-1,4-naphthoquinone possesses activity of the same order as vitamin K_1. All other members of this group which have been tested are less than 1/20 as active as vitamin K_1.

Since the 1,4-naphthoquinones are oil-soluble and water-insoluble they are used in conjunction with bile salts in oral therapy. Due to the large number of patients who because of nausea, intestinal obstruction, or other complications can not be treated orally, it was highly desirable to find a compound of high activity which could be dissolved in an aqueous medium for intravenous use.

Search for an active water-soluble compound led to the examination of 1,4-dihydroxy-2-methylnaphthalene.[24] Although the potency is approximately equal to that of 2-methyl-1,4-naphthoquinone, the solubility in saline is too low for its use in a convenient volume. In spite of the large volume of solvent required, patients were successfully treated by the intravenous injection of aqueous solutions of 2–10 mgs.

The search was continued and a more satisfactory compound from the standpoint of solubility was discovered. 4-amino-2-methyl-1-naphthol hydrochloride[25] is sufficiently soluble in water for convenient intravenous injection and in addition is almost as potent as 2-methyl-1,4-naphthoquinone. This compound was tested because it seemed very probable that deaminization would occur producing 1,4-dihydroxy-2-methylnaphthalene, the high potency of which had already been ascertained.



4-amino-2-methyl-1-naphthol — 1,4-dihydroxy-2-methylnaphthalene — 2-methyl-1,4-naphthoquinone

At the present time the mechanism of the action of vitamin K is not known. In fact, in the case of the simple compounds just discussed we do not know whether the active form is the phenol or the quinone. On the basis of work in the benzene series of compounds, it seems likely that the organism can oxidize the phenol to the quinone or reduce the quinone to the phenol.

The Vitamin K Deficiency

In 1936 Schønheyder[26] examined the blood of chicks suffering from vitamin K deficiency and found that the prolonged clotting time of the blood was due to a diminution in thrombin. Previously, Quick, Stanley-Brown and Bancroft[27] (1935) had devised a method for the determination of prothrombin and through the use of this procedure had found subnormal values for prothrombin in jaundiced patients. Shortly after the publication of this report, Warner, Brinkhous and Smith[28] published another method for the determination of prothrombin, and Hawkins and Brinkhous showed that the blood of the dog having a bile fistula was deficient in prothrombin.

Although Dam[29] had little success in producing the

[22] McKee, Binkley, MacCorquodale, Thayer and Doisy, *Jour. Am. Chem. Soc.*, 61: 1295, 1939.

[23] Almquist and Klose, *Jour. Am. Chem. Soc.*, 61: 1611, 1923, 1939; Thayer, Cheney, Binkley, MacCorquodale and Doisy, *Jour. Am. Chem. Soc.*, 61: 1932, 1939; Fieser, Bowen, Campbell, Fieser, Fry, Jones, Riegel, Schweitzer and Smith, *Jour. Am. Chem. Soc.*, 61: 1925, 1939; Fieser, Bowen, Campbell, Fry and Gates, *Jour. Am. Chem. Soc.*, 61: 1926, 1939; Ansbacher and Fernholz, *Jour. Am. Chem. Soc.*, 61: 1924, 1939.

[24] Thayer, Binkley, MacCorquodale, Doisy, Emmett, Brown and Bird, *Jour. Am. Chem., Soc.*, 61: 2563, 1939.

[25] Doisy, MacCorquodale, Thayer, Binkley and McKee, SCIENCE, 90: 407, 1939.

[26] Schønheyder, *Biochem. Jour.*, 30: 890, 1939.

[27] Quick, Stanley-Brown and Bancroft, *Am. Jour. Med. Sci.*, 190: 501, 1935.

[28] Warner, Brinkhous and Smith, *Am. Jour. Physiol.*, 114: 667, 1936; Hawkins and Brinkhous, *Jour. Exp. Med.*, 63: 795, 1936.

[29] Dam, Schønheyder and Lewis, *Biochem. Jour.*, 31: 22, 1937; Greaves and Schmidt, *Proc. Soc. Exp. Biol. and Med.*, 37: 43, 1937.

hemorrhagic syndrome in the common laboratory mammals, Greaves and Schmidt showed that the blood of rats with bile fistulas had a decreased content of prothrombin and a prolonged coagulation time. They attributed this condition to the failure of absorption of vitamin K in the absence of bile. Quick[30] summarized the available data and suggested that vitamin K should be effective in the treatment of the hemorrhagic diathesis of obstructive jaundice.

With the stage thus set by the investigations referred to in the two preceding paragraphs, it was only logical to make the next move—namely, the study of the effect of vitamin K in obstructive jaundice. The first report on the therapeutic use of vitamin K in the treatment of bleeding in cases of obstructive jaundice was published by Warner, Brinkhous and Smith (1938),[31] but within a very short time Butt, Snell and Osterberg and Dam and Glavind published their observations on the same subject. Several additional publications, chiefly from the Mayo and Iowa groups, have now appeared. In addition to the treatment of obstructive jaundice and other conditions in which absorption from the intestine is impaired due to a lack of bile in the intestine Waddell and Guerry[32] have successfully utilized vitamin K for the treatment of spontaneous and traumatic hemorrhage of the newborn. Brinkhous, Smith and Warner had previously shown that the prothrombin of the blood of babies is subnormal in amount.

SUMMARY

During the decade following Dam's first observations on the hemorrhagic syndrome the combined efforts of several groups of investigators have solved many of the important problems connected with the new vitamin. Sources of vitamin K were discovered, methods of extraction and purification devised, the isolation effected, the structure of K_1 worked out and then verified by synthesis, and a promising start made on the therapeutic applications. In addition, simple water soluble compounds with antihemorrhagic properties have been supplied for clinical work. Preliminary results with these compounds are encouraging.

OBITUARY

FERDINAND AUGUSTUS SILCOX
1882–1939

FERDINAND AUGUSTUS SILCOX, chief forester of the U. S. Forest Service, died at his home in Alexandria, Virginia, on December 20, 1939. The country has lost one of its most distinguished foresters and one of its ablest public servants.

Mr. Silcox was one of the first southerners to enter the profession of forestry. He was born in Columbus, Georgia, and received his undergraduate training in the College of Charleston in South Carolina. He completed graduate work at the Yale School of Forestry in 1905, and was immediately given an appointment in the Forest Service. That was the year in which the administration of the National Forests was placed in the Department of Agriculture under Gifford Pinchot. The progressive withdrawal of forest lands from the public domain as permanent reservations was still under way. Mr. Pinchot had only begun the organization of the National Forest units and development of an effective system of protection and management. Silcox was thus one of the pioneers in National Forest work. He rose rapidly from the positions of field assistant and forest ranger to that of assistant district forester in the northern Rocky Mountain region. In 1911 he was appointed district forester, succeeding William B. Greeley, who later became chief forester of the Forest Service.

The constructive activities and influence of Silcox were of great importance in the evolution of policies and management of the public forests under his charge. He rendered valuable service in administrative organization, skilful management of forest labor, systematic fire control, development of forestry practice in timber sales, regulation of grazing, fighting fraud in application of mining laws and in previously established homestead claims, and meeting many other problems that in those days were in the early stage of solution.

At the time Silcox was district forester there was trouble in the lumber camps through the activities of the I.W.W. At one time during a very dry season when hundreds of men were needed in the suppression of fires in the forests, the workers refused to fight fire. Through skilful negotiation with labor leaders Silcox secured the cooperation of the I.W.W. to aid in protecting the public forests. This incident is important because it called attention to his ability in labor matters and was doubtless a factor in his assignments during the war. He was commissioned captain in the 20th Engineers and later promoted to the rank of major. Under joint action of the Department of Labor and the Shipping Board he was delegated to handle labor relations in the Seattle shipyards and in spruce production for airplanes. After 1919 he served as director of industrial relations for the Ty-

[30] Quick, *Jour. Am. Med. Assn.*, 109: 66, 1937.

[31] Warner, Brinkhous and Smith, *Proc. Soc. Exp. Biol. and Med.*, 37: 628, 1938; Butt, Snell and Osterberg, *Proc. Staff Meetings Mayo Clinic*, 13: 74, 1938; Dam and Glavind, *Acta Med. Scand.*, 96: 108, 1938.

[32] Waddell and Guerry, *Jour. Am. Med. Assn.*, 112: 2259, 1939; Brinkhous, Smith and Warner, *Am. Jour. Med. Sci.*, 193: 475, 1937.

pothetae of America, and occupied a similar position for the New York Employing Printers' Association. While working for the latter he organized a system of apprentice schools in which he took great pride.

Silcox was appointed chief forester in 1933. His early experiences in the Forest Service and subsequent activities in labor relations counted large in his success in his new position. They were a foundation for his keen appreciation of the social aspects of the forestry problem. A major objective of forestry is to ensure sustained production of forests that will provide employment through industrial activities in forest and mill and thereby a stable support of local communities. Silcox has given special emphasis to this problem in his national program of forestry. In the recent expansion of public activities in forestry, he demonstrated great ability as an organizer, executive and personal leader. He was awarded the honorary degree of LL.D. by the College of Charleston and by the University of Syracuse for his distinguished achievements.

Silcox had a brilliant mind, keen power of analysis, extraordinary grasp of detail and an unusual memory. He had high ideals of public service which were reflected throughout his organization. He was also a realist, fully appreciating the obstacles to rapid achievement of his objectives.

His interests were broad, and he was very well read. He had unlimited courage, without a trace of self-interest. He was a man of great personal charm. He was widely admired and respected for his abilities and achievements. He had the affectionate regard of a host of friends who were attached to him through his personal qualities and who deeply mourn his death.

HENRY S. GRAVES

NEW HAVEN, CONN.
DECEMBER 27, 1939

RECENT DEATHS AND MEMORIALS

DR. HENRY MCELDERRY KNOWER, formerly associate in anatomy at the Johns Hopkins University and later professor of anatomy at the University of Cincinnati, died on January 10 at the age of seventy-one years.

PROFESSOR ALBERT DEFOREST PALMER, until his retirement as emeritus in 1934 associate professor of physics at Brown University, with which he had been connected for forty-six years, died on January 13 at the age of seventy years.

DR. HARRY MILLIKEN JENNISON, since 1923 professor of botany at the University of Tennessee, died on January 5, in his fifty-fifth year.

THE death is announced of Dr. Wilfred A. Welter, professor of biology and head of the department at the Morehead State Teachers College, Kentucky.

CARL GEORGE LANGE BARTH, consulting mechanical and industrial engineer, retired, of Philadelphia, died on October 28 at the age of seventy-nine years.

DR. KAKUGORO NAKATA, of the Botanical Institute of the Faculty of Agriculture of the Imperial University of Kyushu, Fukuoka, Japan, died on November 14. A correspondent writes: "He had recently returned from an extended tour of North China. Dr. Nakata was well known and highly esteemed by plant pathologists in America, where he had spent about two years (1919–1920) studying occidental methods of research, dividing his time between the University of California, the University of Wisconsin and the Laboratory of Plant Pathology, Bureau of Plant Industry, U. S. Department of Agriculture. He returned to this country for a shorter period in 1934."

A MEMORIAL tablet in honor of Lord Rutherford has been placed by the Historic Sites Monuments Board of Canada on the outside wall of the Macdonald Physics Laboratory of McGill University, where he was for nine years professor of physics. The inscription on the tablet reads:

ERNEST RUTHERFORD
Baron Rutherford of Nelson, O. M.
1871–1937

Here Lord Rutherford, Macdonald Professor of Physics, 1898–1907, made fundamental discoveries respecting radioactivity, the transmutation of matter, and the structure of atoms; foremost experimental physicist in his time, he advanced greatly the frontiers of knowledge, and opened new paths for the progress of science and human welfare.

A.D. 1939

SCIENTIFIC EVENTS

THE CANCER INSTITUTE OF MEDICINE AT BUENOS AIRES

THE correspondent at Buenos Aires of the *Journal* of the American Medical Association reports that a new six-story pavilion has been added to the Institute of Experimental Medicine for the Study and Treatment of Cancer in Buenos Aires. The dedication took place on December 12. The pavilion contains 250 beds in separate rooms, thus increasing the total capacity to 550 beds and two well-equipped air-conditioned surgical rooms. All modern ideas of hospital technic were incorporated in its construction and equipment. The cost amounted to about 1,000,000 pesos (about $300,000). This Cancer Institute founded in 1923 is connected with the University of Buenos Aires and has been for sixteen years under the

direction of Professor A. H. Roffo, its founder. The original hospital consisted of one building. Now there are thirteen buildings, inclusive of the new pavilion, which occupy an area of 12½ acres. Its annual budget is 260,000 (Argentine) pesos (about $78,550), with additional donations and endowments.

The work of the institute is done in three divisions: medical research, diagnosis and treatment and social welfare. The research activities are devoted to the experimental study of cancer, biochemistry, physical chemistry, experimental pathology, pathologic anatomy, tissue culture, radiobiology and experimental surgery. The diagnostic division has a dispensary for the early diagnosis and treatment of outpatients. Up to the beginning of 1939, 82,000 patients had been examined in the dispensary; clinical treatment is in the hands of specialists. The annual number of patients has risen from 1,772 in 1923 to 8,554 in 1938, the number of consultations from 6,767 to 91,752, the number of treatments from 3,900 to 50,279. The total number of treatments (end of 1938) was 354,000. In 1923, 422 persons were admitted; in 1938, 3,174; altogether 27,599. The division of social welfare does not confine itself to handling patients of the institute. It seeks to educate the public by means of pamphlets and lectures. A "cancer hour" is held every Saturday, in which the schools may participate. There is a visiting nurse service which accords special attention to carcinomatous housewives and mothers. There is also a school of nurses.

Dr. Roffo recently was made an Officer of the Legion of Honor at a ceremony at which the French Ambassador presented him with a check for a hundred thousand francs for the foundation of a fund for the study of cancer.

COOPER UNION ENGINEERING CAMP

PLANS to establish an engineering camp for Cooper Union, New York City, on the Hewitt estate in the Ramapo Mountains near Ringwood, N. J., were adopted at a recent meeting of the Cooper Union Board of Trustees. Norvin Hewitt Green has offered to convey by gift a tract of 150 acres to the union as a memorial to his mother, the late Amy Hewitt Green, daughter of Abram S. Hewitt, former mayor of New York, and granddaughter of Peter Cooper. Title to the property, which will be known as the Green Engineering Camp and which includes twenty farm buildings and tenant houses, will pass to Cooper Union early in January. Development work will be started at once, and the camp will be opened in 1940 as a summer center of engineering education.

In describing Mr. Green's benefaction Dr. Gano Dunn, president of the union, pointed out that

> the Cooper and Hewitt families have been intimately associated with the institution since its founding by Peter Cooper in 1859 as a free school for the education of the working classes, and have made vital contributions to its progress.
>
> For years, in the absence of an engineering camp of the kind enjoyed by many universities and other institutions of learning, the engineering students of Cooper Union have been obliged to learn the art of surveying by setting up their instruments and running their lines in Central Park, which a friendly city administration permitted them to do.
>
> The camp site is especially adaptable to engineering work. Comprising large areas of meadow land and wooded slopes, the property is adjacent to a variety of geological formations and mines.
>
> The trustees have decided to carry out at the camp not only the engineering activities related to surveying, but other activities associated with summer camps in connection with the development of the fine arts, and with the general objective of the social betterment of the students of Cooper Union.
>
> All field work in engineering will be carried on at the Green Engineering Camp, thus making it possible to devote more of the regular school curriculum to languages, history and other liberal arts subjects under the department of humanities, created this year with a view of developing a rounded culture in Cooper Union students.
>
> The limitations on education resulting from a strictly urban location are recognized. It is indeed fortunate that Cooper Union will now be enabled to offer its students, six sevenths of whom come from New York and Brooklyn, country advantages in education and recreation.

Administration of the camp will be in charge of Dr. Edwin Sharp Burdell, director of the union. While at the outset educational activities will be provided for the schools of engineering, it is planned eventually also to make provision for the art schools. Week-end expeditions of student and faculty groups will be a winter feature. Buildings will be remodeled to provide instrument rooms, blue printing and dark rooms, recreation and reading rooms, a social hall, a mess hall, a kitchen, store rooms, a general workshop for repairs and handicraft work, drafting rooms, a lecture hall and an infirmary. Facilities will ultimately be provided for outdoor sports, including tennis, baseball, volleyball and swimming.

THE OBSERVATORY OF THE CASE SCHOOL OF APPLIED SCIENCE

GIFTS amounting to the sum of $123,000 have been made to the Case School of Applied Science in Cleveland for the purpose of enlarging the present Warner and Swasey Observatory, of providing it with an auditorium for public lectures and of installing a new and powerful telescope. These gifts have come mainly from those associated with the founders of the Warner and Swasey Company, Worcester R. Warner and Ambrose Swasey. The auditorium, a memorial to Mr. Warner, is the gift of his widow, Mrs. Worcester R.

Warner, and his daughter, Miss Helen Blakemore Warner. The telescope, the gift of Mrs. Edward Parker Burrell, is to be a memorial to her husband, who was for many years director of engineering for the Warner and Swasey Company. Others have provided additional gifts.

Construction of the addition will begin as soon as working plans are completed. The present observatory, situated at Taylor and Brunswick Roads, East Cleveland, was a gift to Case School in 1920 from Mr. Warner and Mr. Swasey, who were both trustees of the college. The present observatory contains the 10-inch equatorial telescope which was originally in the private observatory maintained by the donors.

The new telescope will be an instrument of such power that it will be possible to photograph objects many million light years away. It will be mounted in a 28-foot dome and will have a 36-inch mirror and a 24-inch lens. The optics of the instrument are of recent design, which utilizes the best properties of the reflecting and of the refracting type of telescope.

Below the dome in which the telescope will be mounted will be an exhibition hall for the display of models, globes, transparencies and other visual exhibits. Adjoining the hall will be the auditorium, which will be of the amphitheater type and which will seat 120 persons. On the same level will be two faculty offices. On a lower level, naturally lighted because of the contour of the land, will be a computation and recitation room, two research laboratories, a shop and living quarters for an observer. The addition, constructed of steel and concrete, will be faced with pressed brick with a stone trim to conform to the present building. Plans are being prepared by Walker and Weeks, of Cleveland. These have been developed from earlier drawings and models by O. M. Stone, assistant professor of engineering drawing at Case School.

EXPEDITIONS OF THE FIELD MUSEUM, CHICAGO

DR. CLIFFORD C. GREGG, director of the Field Museum, has issued a statement reviewing the activities of the museum during 1939. Among the expeditions of the year were the Magellanic Expedition of the Field Museum (which continues work in 1940), collecting zoological specimens in Peru, Bolivia, Chile, the shore of the Straits of Magellan and the island of Tierra del Fuego at South America's extreme tip. This expedition is sponsored by Stanley Field, president of the museum, and led by Dr. Wilfred H. Osgood, chief curator of zoology. Other members are Colin C. Sanborn, curator of mammals; Karl P. Schmidt, curator of amphibians and reptiles, and John Schmidt. A prime objective is the assembling of data to supplement the work of Charles Darwin, who explored the more remote parts of this area.

The Field Museum Archeological Expedition to the Southwest, also sponsored by President Field, was led by Dr. Paul S. Martin, chief curator of anthropology, who was assisted by several other archeologists, and a party of excavators. Ruins of early Mogollon culture were investigated, and a large collection of artifacts obtained. Dr. Martin discovered traces of cultural developments that took place during a 1,500-year period which had previously been a blind gap to archeologists.

Comprehensive collections of the flora of Guatemala were made by two botanical expeditions, one sponsored by Sewell Avery and led by Paul C. Standley, curator of the herbarium; the other sponsored by President Field and led by Dr. Julian A. Steyermark, assistant curator of the herbarium. An important collection of fossil mammals, including a genus hitherto unknown to science, was made by an expedition in western Colorado, led by Bryan Patterson, assistant curator of paleontology. Dr. Fritz Haas, curator of lower invertebrates, and Staff Taxidermist Leon L. Walters, conducted an expedition in Florida which collected marine animals and made studies of invertebrate life. An expedition to South Dakota and Nebraska, led by Paul O. McGraw, of the division of paleontology, collected skeletal material representing various species of extinct mammals. Dr. Francis Drouet, curator of cryptogamic botany, is leader of an expedition collecting plants in Mexico and the southwestern United States. The Sewell Avery Zoological Expedition to British Guiana, which had begun operations in 1938, completed its work and returned to Chicago early in 1939. Emmet R. Blake, assistant curator of birds, was the leader.

THE NEW YORK MEETING OF THE AMERICAN PHYSICAL SOCIETY

THE two hundred and thirty-third regular meeting of the American Physical Society will be held in New York City on Friday and Saturday, February 23 and 24, as a joint meeting with the Optical Society of America and the Inter-Society Color Council. Simultaneous sessions for the reading of contributed papers of the American Physical Society and the Optical Society of America will be held on Friday and Saturday, February 22 and 23, at Columbia University. A special symposium of invited papers on "Optical Methods for the Study of Molecular Structure" will be presented at a joint session on the morning of February 23, in the Pupin Physics Laboratories. The following papers will be presented: "The X-Ray Diffraction Method," by Dr. E. B. Warren, of the Massachusetts Institute of Technol-

ogy; "The Electronic Diffraction Method," by Dr. Louis R. Maxwell, of the Department of Agricultural Chemistry and Engineering of the U. S. Department of Agriculture; "The Band Structure Method," by Dr. R. Bowling Barnes, of the American Cyanamid Company, and "The Raman Spectra Method," by Dr. George M. Murphy, of Yale University.

The sessions of the Optical Society for the reading of papers will open on Wednesday, February 21.

The sessions of the Inter-Society Color Council will be held on Wednesday and Thursday, in the Hendrick Hudson Room of the Roosevelt Hotel and in the auditorium of the Electrical and Gas Association, 480 Lexington Avenue. On Wednesday there will be an afternoon technical session on "Spectrophotometry in the Pulp and Paper Industry" sponsored jointly by the Technical Association of the Pulp and Paper Industry, and an evening popular session, a Parade of Color, to consist of recent or interesting color developments in the fields covered by the various member bodies of the council. On Thursday there will be a morning discussion session for which topics will be announced, and an afternoon business session.

A joint dinner of the three organizations has been planned for Friday evening. A *Bulletin* of the American Physical Society containing a program of the meeting, including abstracts of contributed papers and details of the session, will be mailed to members about February 2.

AWARDS OF THE GEOLOGICAL SOCIETY, LONDON

THE council of the Geological Society, London, has made the following awards:

The Wollaston Medal.—Henry Woods, formerly university lecturer in paleontology in the University of Cambridge, in recognition of the value of his researches into the mineral structure of the earth, especially his studies of fossil Mollusca and Cretacea from the Cretaceous formations of Great Britain, Africa and New Zealand.

The Murchison Medal.—Dr. Arthur Holmes, professor of geology in the University of Durham, in recognition of the value of his petrological researches and of his stimulating studies concerning the composition and physical state of the earth's interior.

The Lyell Medal.—Dr. H. L. Hawkins, professor of geology in the University of Reading, for his eminence in paleontology, particularly in his studies of the Echinoidea, and for his researches in Eocene stratigraphy.

The Wollaston Fund.—Miss Dorothea M. A. Bate, for her investigations of Pleistocene mammalian faunas in Palestine and the Mediterranean.

The Murchison Fund.—Archibald Gordon Macgregor, for his petrological researches into Scottish rocks and his work on the geology of Monserrat.

A moiety of the Lyell Fund.—Miss Dorothy Hill, for her researches on Paleozoic corals.

A second moiety of the Lyell Fund.—L. H. Tonks, for his work on the Carboniferous rocks of Lancashire and Northumberland.

SCIENTIFIC NOTES AND NEWS

THE seventy-fifth birthday of Dr. George H. Parker, professor emeritus of zoology at Harvard University, which occurred on December 23, was celebrated by presenting to him a volume of letters from students, associates and friends. He was further honored by a reception on January 8, held at the Harvard Faculty Club, at which time his portrait, the work of Charles Hopkinson and a gift from students and colleagues, was presented to the university. The portrait will be hung in the Biological Laboratories. Professor Parker graduated from Harvard College in 1887. He joined the faculty in 1888 and became professor emeritus in 1935.

AT the luncheon of the American Science Teachers Association, held in Columbus on December 31, a volume of letters was presented from associates, friends and former students to Dr. Otis W. Caldwell, professor emeritus of Teachers College, Columbia University, formerly professor of botany at the University of Chicago, now general secretary of the American Association for the Advancement of Science. The address at the luncheon was made by Dr. Walter B. Cannon, professor of physiology at Harvard University, president of the association.

MATTHEW W. STIRLING, chief of the Bureau of American Ethnology of the Smithsonian Institution, and Bradford Washburn, director of the New England Museum of Natural History, Boston, have been awarded Franklin L. Burr Prizes of $1,000 each by the National Geographic Society. The prize to Mr. Stirling was in recognition of his discovery in 1939, in the State of Vera Cruz, Mexico, of a monument bearing the earliest recorded date yet discovered in the New World—a date in Maya symbols corresponding to 291 B.C. of the Christian calendar, and the uncovering of other carvings and artifacts shedding light on early civilization in Mexico. The prize to Mr. Washburn was for his exploration by air and for his aerial photography during the last three years of glaciers and parts of glacier systems not previously known to exist in Alaska near Mount St. Elias.

GEORGE JACKSON MEAD, vice-president and director of the United Aircraft Corporation, vice-chairman of the National Advisory Committee for Aeronautics,

has been awarded the Sylvanus Albert Reed Award for 1939 of the Institute of the Aeronautical Sciences, in recognition of his participation in the development of radial aircraft engines for military and commercial services. The presentation will be made at the "honors night" dinner of the institute on January 26.

DR. W. J. V. OSTERHOUT, of the Rockefeller Institute for Medical Research, New York City, was elected at the Columbus meeting Charles Reid Barnes honorary life member of the American Society of Plant Physiologists. Dr. Osterhout is the sixteenth plant physiologist elected to the honorary membership which is named after the late Dr. Charles Reid Barnes, of the University of Chicago, one of the founders of the science of plant physiology in America.

DR. ISAIAH BOWMAN, president of the Johns Hopkins University, has been elected an honorary member of the Explorers' Club of New York City.

HERBERT J. SPINDEN, curator of American Indian art and primitive cultures at the Brooklyn, N. Y., Museum, has been made chairman of the section of anthropological sciences at the eighth American Scientific Congress, which will be held from May 10 to 18 at Washington, D. C.

IT is reported in *Nature* that at a meeting of the Council of the National Institute of Sciences of India in Calcutta, the following were elected fellows of the institute: *Ordinary Fellows:* Dr. K. Banerjee, reader in physics, University of Dacca; Dr. F. R. Bharucha, professor of botany and head of the department, Royal Institute of Science, Bombay; Dr. R. N. Ghosh, reader in physics, University of Allahabad; Professor H. K. Mookerjee, university professor of zoology and head of the department of the University of Calcutta; Professor V. V. Narlikar, professor of mathematics and head of the department, Benares Hindu University; Dr. C. G. Pandit, officiating director of the King Institute of Preventive Medicine, Guindy, Madras; Major C. L. Pasricha, professor of pathology and bacteriology, School of Tropical Medicine, Calcutta; Professor L. Rama Rao, professor of geology, University of Mysore; Dr. M. Sharif, entomologist, Haffkine Institute, Bombay; Dr. K. Venkataraman, director of the University of Bombay Laboratories of Chemical Technology and Textile Chemistry. *Honorary Fellow:* Dr. E. V. Appleton, secretary of the Department of Scientific and Industrial Research.

DR. EDMUND WARE SINNOTT, professor of botany at Barnard College, Columbia University, has been appointed Sterling professor of botany, chairman of the department and director of the Marsh Botanical Gardens at Yale University. The appointment will become effective on July 1.

DR. PERRIN H. LONG, professor of medicine in the School of Medicine of the Johns Hopkins University, has been appointed head of the new department of preventive medicine. The department was established through a grant from the Rockefeller Foundation of $350,000 over the next ten years.

HOWARD LANDIS BEVIS, William Ziegler professor of law and government in the Graduate School of Business Administration at Harvard University, at one time Ohio state director of finance and judge of the Supreme Court of the state, has been elected president of the Ohio State University. Dr. William McPherson, emeritus professor of chemistry and dean of the Graduate School, has been *interim* president since the retirement as president emeritus of Dr. George W. Rightmire.

DR. A. R. PATTON, of the Colorado Agricultural Experiment Station, has been made head of the department of chemistry of the Montana Agricultural Experiment Station.

THE Committee on Therapeutic Research of the American Medical Association has made a grant to Dr. Harry Beckman, director of the department of pharmacology at the School of Medicine of Marquette University, Milwaukee, for his work on the prophylaxis of mosquito-transmitted avian malaria.

AFTER twenty-three years of service, Professor George R. La Rue has resigned the directorship of the University of Michigan Biological Station. His successor is Dr. Alfred H. Stockard, assistant professor of zoology at the University of Michigan, and for the past nine years secretary to the station.

DEWEY DEFOREST KNOWLES, director of research and development for the Raytheon Production Corporation, Boston, Mass., has joined the research engineering staff of the special products department at Bloomfield, N. J., of the Westinghouse Electric Company.

DR. HAROLD W. SCHULTZ, instructor in the department of physiology of the Ohio State University, has become a member of the staff of Arthur D. Little, Inc., of Cambridge, Mass., to carry on biochemical studies in the fields of nutritional and pharmaceutical research and development.

DR. ARTHUR PERCY SAUNDERS, Childs professor of chemistry emeritus at Hamilton College, has been elected a member of the Board of Managers of the New York Botanical Garden.

THE Board of Managers of the Wistar Institute announces the following additions to the Advisory Board: Dr. J. S. Nicholas, Osborn Zoological Laboratory, Yale University; Dr. George B. Wislocki, department of anatomy, Harvard Medical School; Dr.

George W. Corner, School of Medicine and Dentistry, University of Rochester, New York.

DR. HENRY S. GRAVES, dean emeritus of the Yale School of Forestry, has accepted an assignment from the General Education Board of New York, to make an extended investigation of the problems of education and research in forestry in the southern states.

THE New York Chapter of the American Institute of Chemists will hold a dinner meeting at the Chemists' Club on January 19. Dr. W. Landis, vice-president of the American Cyanamid Company, will make an address entitled "The Training of the Chemical Executive."

DR. F. G. BRICKWEDDE, chief of the cryogenic laboratory of the National Bureau of Standards, delivered his address as the retiring president of the Philosophical Society of Washington at the Cosmos Club on the evening of January 6. He spoke on "Some Complexities of the Simple Element Hydrogen."

DR. ENRICO FERMI, professor of physics at Columbia University, gave a lecture entitled "Nuclear Bombardment with Neutrons" at the Franklin Institute, Philadelphia, on January 17.

PROFESSOR H. JERMAIN CREIGHTON, chairman of the department of chemistry of Swarthmore College and president of the Electrochemical Society, addressed on January 9 the Cleveland section of the society on "The Electrochemical Reduction of Sugars."

THE Dunning Science Building, presented to Washington College, Chestertown, Md., by Dr. H. A. B. Dunning, of Baltimore, was dedicated on January 16. Speakers at the exercises included: President Isaiah Bowman, of the Johns Hopkins University; Dr. E. K. Marshall, Jr., and Dr. Donald H. Andrews, both of the university, and Dr. Guy E. Snavely, executive director of the Association of American Colleges, New York.

THE Midwestern Psychological Association will hold its annual meeting on May 3 and 4 at the department of psychology of the University of Chicago. Professor F. A. Kingsbury is acting as local chairman for the meetings. The presidential address will be given by Professor J. P. Guilford, of the University of Nebraska. In addition a full program of research papers and symposia is being arranged by the program committee under Professor Fred McKinney, of the University of Missouri.

THE annual meeting and banquet of the Torrey Botanical Club was held at the Men's Faculty Club, Columbia University, Tuesday evening, January 9. The following members were announced as having been elected as officers for 1940: *President,* B. O. Dodge; *First Vice-president,* G. T. Hastings; *Second Vice-president,* E. B. Matzke; *Editor,* H. W. Rickett; *Corresponding Secretary,* J. S. Karling; *Recording Secretary,* Miss Clyde Chandler; *Treasurer,* H. N. Moldenke; *Business Manager,* M. Levine; *Bibliographer,* Mrs. F. Kavanagh. Among the items discussed at this meeting were the proposals for the establishment of a John Torrey Lectureship in botany and a Pan-American Botanical Congress.

GIFTS for research amounting to $132,559 have been made to the University of Pennsylvania as part of its bicentennial fund. These include: Commonwealth Fund, $27,255 for streptococcus research, kidney research and study of air-borne infections; Rockefeller Foundation, $12,650 for industrial research and other medical studies; Smith, Kline and French Laboratories, $19,956 for physiologic chemistry, diabetes, dermatology and gastrointestinal research; Estate of George S. Cox, $6,250 for research in diabetes; National Tuberculosis Association, $5,971 for study of the chemistry of the tubercle bacillus and research on x-ray technic; National Committee on Mental Hygiene, $2,500 for research in dementia praecox; Nemours Foundation, $2,400 for a fellowship in pediatrics; International Cancer Research Foundation, $1,415 for study of malignant tumors in frogs and x-ray therapy in larger animals; Parke, Davis and Company, $3,000 for research on pituitary hormones; Abbott Laboratories, $2,500; Merck and Company, Inc., $2,000. The bicentennial celebration opened on January 17, Founders' Day, with a program commemorating the birth of Benjamin Franklin.

THE *Journal* of the American Medical Association writes: "The acquisition of a site for a new Army Medical Library and Museum building in Washington was recommended by the President in the budget for the fiscal year of 1941, which he submitted to Congress on January 4. The budget contemplates that the Congress shall appropriate $600,000 for the purchase of the site and for preliminary expenses in connection with the building to be constructed and that the site be selected on East Capitol Street, in Washington, adjacent to the Congressional Library group. Thus moved one step further toward fruition the hopes and petitions of physicians that a structure be provided in which the vast collection of invaluable medical literature comprising the Army Medical Library, often spoken of as the Surgeon General's Library, may be safely and adequately housed. The Seventy-Fifth Congress authorized the construction of such a building to cost $3,750,000, but did not appropriate any money to make effective its authorization. The recommendation contained in the budget for 1941 is now before the Committee on Appropriations of the House of Representatives."

CLAREMONT COLLEGES, Calif., announces an essay contest under the auspices of the John Muir Enterprise. Manuscripts should be of suitable length for magazine publication but should not exceed 3,000 words, and must reach the judges before February 1. This contest is part of a project to encourage "interest in the study of nature and an appreciation of beauty and other values in nature as a force in noble living." Three prizes are offered of $100, $75 and $50. Each essay should consist of "an original study of some subject in nature or about nature and should embody the appreciation of such factors as beauty, strength, form, variation and other values." Complete information may be obtained by writing to the John Muir Enterprise, Claremont, Calif.

THE *Journal* of the American Medical Association reports that the Kitasato Institute for Infectious Diseases, Tokyo, celebrated its twenty-fifth anniversary on November 5. The institute was founded by Baron Kitasato, the Japanese bacteriologist who discovered the bubonic plague bacillus, after he had served many years as director of the Imperial Japanese Institute for the Study of Infectious Diseases. Baron Kitasato was born in 1856 and died in 1931.

DISCUSSION

STAGNATION OF ICE IN CONNECTICUT

IN a recent review[1] of my report on the physiography of the Quinnipiac-Farmington Lowland in Connecticut,[2] Richard Goldthwait has presented an impartial and highly complimentary summary of my views. However, as a stanch believer in stagnation of ice in New England he has raised a few questions which I take this opportunity to answer. Because stagnant ice is far easier to visualize than to disprove, my report did not attempt to answer all the countless claims for it, but rather to demonstrate by good scientific logic of a normal retreat explanation, as well as by positive disproof of stagnation claims in vital localities, that stagnation in Connecticut is highly improbable.

Thus, although my reviewer made only passing mention of the map of a proglacial delta which I presented in my report to show that a late-Glacial water body existed at Southington, Conn., he was not aware that this map had to be made expressly in order to convince some who had seen the feature in question with me in field conferences that it was indeed a delta, and others who steadfastly believed that the delta lobes were ice contacts formed against ice on the south. In this case it took six weeks of mapping to disprove stagnant ice in one small locality where it had been claimed, but left little doubt that the upper Quinnipiac Valley was uncovered by normal retreat.

With similar purpose Dana's well-known old map of New Haven,[3] sprinkled with elevations, had to be reprinted to make clear that the New Haven Plain is not a horizontal terrace—as all Connecticut terraces have at times been described in stagnation literature. The review mentioned that I detected post-Glacial regional deformation, but did not state that the measurement is 5½ to 6 feet per mile, established by levels that I ran ten years ago, whereas in an equally long period of stagnation studies no measurable deformation had been recognized in Connecticut.

Referring to specific points Goldthwait states that "a few ideas, which supporters of down-wastage may well challenge, are, first, that ice-contact deposits like the Mill River red 'valley train' will show good preservation and down-valley alignment if deposited more or less simultaneously in pools along quasi-stagnant ice masses, but not when deposited one by one around a retreating stubby tongue of active ice." This question concerns the morphology of valley trains. There are numerous text-book illustrations of valley trains formed by streams flowing from retreating stubby tongues of active ice, but I have never seen a case demonstrated in the plentiful pictorial literature on living glaciers where valley trains have been formed in pools along quasi-stagnant ice masses.

"Secondly," it is stated, "the absence of significant early drift in the lower Quinnipiac Valley implies presence of ice there which barred deposition, while the high Mill River and upper Quinnipiac valley received gravels." This statement is misleading because it presents an inference and not a fact. The inference is based on Flint's[4] and not on my field work. I found no lack of "significant early drift" in the lower Quinnipiac Valley in the form of varved clay and deltas which Ward[5] and I both interpret to indicate open water. The submerged condition of the lower Quinnipiac Valley, which made it an effective barrier to the advance of coarse sediment, explains the difference in character and extent of filling by solid matter as compared with the higher, steeper and narrower Mill River Valley, which offered free drainage for a powerful river carrying coarse sand and gravel. The contrast in the two valleys is completely

[1] R. P. Goldthwait, *Jour. Geomorphology*, 2: 166–169, 1939.

[2] R. J. Lougee, Colby Monographs, No. 7, 64 pp., 15 plates: Colby College, Waterville, Maine, 1938.

[3] J. D. Dana, *Am. Jour. Sci.*, 3rd ser., 26: 341–361, 1883; 27: 113–130, 1884, p. 113.

[4] R. F. Flint, *Am. Jour. Sci.*, 5th ser., 27: 81–91, 1934, p. 88.

[5] Freeman Ward, Conn. State Geol. and Nat. Hist. Survey, *Bull.* 29, 78 pp., plates and maps, 1920, p. 55.

accountable without lingering ice, and, indeed, there is no direct evidence of the latter.

"Finally," Goldthwait says, "it must be admitted that undulating pitted outwash, even with local foreset structure, as along the western edge of the Farmington Lowland, is a poor record of an extensive water level, whereas it fits well the picture of long marginal streams and pools." The writer believes this viewpoint arises from a consideration of the seventeen-mile zone of outwash along the western side of the Farmington Lowland as a single deposit rather than from the point of view of the units that compose it. The only general direction of slope and structure is eastward at right angles to the trend of the valley and any hypothetical long marginal streams. This deposit appears to be a connected series of parallel fans spread on land and terminating locally in deltas where they reached standing water. The profile from south to north is highly irregular, and local delta structure is interpretable as marking fluctuating water levels. At one point, nearly opposite the Tariffville Gap, the profile declines abruptly to be resumed at a lower level northward. The only explanation that easily covers all these varied facts is that of a northward retreating ice tongue terminating in a general valley lake that created a high but fluctuating base level for the outwash surfaces until the end of the tongue retreated north of the Gap with consequent draining of the lake and abrupt lowering of base level for all later outwash. The concept of a stagnant ice block and pools[6] was thoroughly considered and found to explain some details but not the complex combination of interrelated features of the Farmington Lowland.

Referring to the color distinction between old red and younger yellow or buff sediments in the Lowland, Goldthwait says, "Lougee does not mention the excellent work by Krynine[7] on these sediments." With this statement the writer can not agree. It is true that this particular paper written by Krynine with suggestions and criticisms by Flint was not quoted in my report, but this was because its conclusions, based on petrographic analysis, were of doubtful correlative value in my physiographic study. An example will make my meaning clear:

I have described and pictured[8] a massive deposit of fine light tan- or buff-colored dune sand that the prevailing westerly winds have drifted against the eastern margin of the Quinnipiac Lowland, three quarters of a mile northeast of Fair Haven. It is traceable high up the slopes, at least to 70 feet elevation, and is still actively blowing into drifts where stripped of vegetation. The composition shows that the dune was probably blown up from the adjacent river flood plain a few hundred feet away, where, after the valley had been drained of static water, a train of yellow or buff sand was spread somewhat below the present salt-marsh level by a glacial river from the Farmington Lowland. Buff sand did not enter the lower Quinnipiac Valley until some time after the ice had retired to the vicinity of Plainville, 24 miles away. Interfingering with the smoothly bedded dune sand are a few lenses of Triassic red gravel or till washed down on the growing dune from the till-covered hill slopes above.

Interpreting a sample from this locality Krynine says:[9]

> A high silt and clay content is characteristic of sediments formed in ponded bodies of water from which the finer grade sizes can not escape. Specimen 19 shows a mixed character (fine grain size, high mica content, high Triassic admixture and relatively high content of very fine sand and silt), and in addition shows horizontal banding and is found on the very border of the lowland and at a much higher level than the other ice-free deposits. High-velocity material in a low-velocity deposit suggests an abrupt decrease in stream velocity immediately before deposition. The field appearance and position of the deposit indicate that it was on the fringe of the basin of sedimentation and was built by high waters rich in Triassic admixture, which, however, reached it only after depositing part of their coarse material near the center of the valley. Partial closure through abutment against the valley border resulted in a high content of fine sand and silt. This sand can be interpreted as a high-level flood-plain border deposit built by exceptional floods. The alternative hypothesis is a marginal valley deposit at approximately the same level with the main surface of deposition, away from the main channels of swifter currents and coarser sediments and reached only by sedimentation at times when stream volume and velocity were high. Such an interpretation implies that, at least in the lower part of the Quinnipiac Valley, the orginal surface of "buff" deposition was from ten to 20 feet higher than the present surface and that a considerable amount of "buff" sand has been flushed out of the valley by recent streams.

Needless to say, this deposit, which is assigned an ice-contact symbol on Flint's latest geologic map,[10] shows to what variety of interpretation the glacial sediments of Connecticut have been subjected.

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MACROCOSMS IN VITRO

IT is hoped that the writer may be pardoned this rather flamboyant title here used to introduce a few

[6] R. F. Flint, *op. cit.*, pp. 88–89.
[7] P. D. Krynine, *Amer. Jour. Sci.*, 5th ser., 33: 111–139, 1937.
[8] R. J. Lougee, *op. cit.*, p. 34 and Plate IV–B.
[9] P. D. Krynine, *op. cit.*, p. 133.
[10] R. F. Flint, *op. cit.*, Fig. 2. p. 82.

remarks anent certain phenomena which he has observed taking place in his beakers.

The first is an easily reproduced observation which presents a singularly beautiful analogy to the formation of spiral nebulae from unorganized dispersions of matter and the further condensation of nebulae into star masses. The operation is so commonplace that the result must needs have been observed innumerable times. When a solution containing some considerable amount of lead has been evaporated strongly with sulfuric acid, then cooled and diluted with water, there is formed a dispersed cloud of precipitated lead sulfate throughout the solution, which cloud we may perhaps think of as resembling a primal chaos of matter in space.

When the chemist, deputy demi-urge pro tem, gives to his beaker a rapid swirl to better mix and settle the precipitate, a very striking demonstration follows. Almost immediately a nucleus of precipitate forms at the center of rotation of the liquid. About this nucleus rotate spiral arms of matter which quickly draw in toward the center. One can not but be impressed by the close resemblance between the appearance of this formation and that of the photographs of the great spiral nebula in Orion. In the beaker the micro-nebula endures but a few seconds, for the arms are quickly absorbed by, and coalesce with, the central nucleus, forming a disk-shaped "star" which, in a gravitationless field, had certainly been globular in shape.

The writer has not sufficient temerity to draw a rigid parallel between the phenomenon here described and that taking place in the nighted dark of infinite space, but it is suggested that some similar cause must control the two cases.

A second observation has to do with a condition which may not be reproducible and which may present itself but once in a lifetime. Recently the writer was diluting, with a jet of water, a concentrated solution of various sulfates in sulfuric acid, using the caution advisable in such cases. The first few drops of water formed a number of globular pearls upon the surface of the liquid, which droplets were almost immediately absorbed with the exception of two which remained upon the surface for a fleeting instant. The larger of these droplets, perhaps three millimeters in diameter, came to rest near the center of the beaker, while the other, very minute, skipped across the surface, approaching the larger with increasing speed until it reached a maximum of velocity near its primary and went whirling around it and away in what may have been a parabolic or elliptical path. The wall of the beaker unfortunately intervened, and the droplet disappeared. The writer was forcibly reminded of the behavior of a comet which falls from infinite distance toward the sun, around which it swings at maximum speed while endures the balance between the centrifugal and gravitational forces, to go winging away into space again as the centrifugal force predominates.

The increase in velocity of the smaller droplet as it neared the greater may have been due to the depression of the surface of the liquid by the weight of the latter, so that the former may really have been running down hill in its approach. If such be the case, then we may have here an observation duplicating Einstein's analogy of gravitation. Perhaps we may surprise the workings of universal law in the ridiculous as in the sublime, in a chemist's beaker as in infinite space.

J. ROBERT WELLS

LA OROYA, PERÚ

TORNADO CLOUD SEEN IN ALASKA

TORNADOES have never been reported from Alaska, although Sir Douglas Mawson, in "The Home of the Blizzard," reports the occurrence of tornadoes—"whirlies," he calls them—in the Antarctic.

On August 3, 1939, the writer was at the Adam Werner farm in Sec. 20, T. 18 N., R 2 E., in the Matanuska Valley. This farm is three miles north-northwest from Palmer, Alaska. About 2 P.M. some very heavy storm clouds were seen to the westward with an unmistakable tornado funnel silhouetted against a more distant area of lighter-appearing clouds.

The stormy looking clouds with appended tornado funnel appeared to be about 20 or 25 miles distant and about S. 85° W. from the point where seen. This would place the clouds about 25 miles north of Anchorage, Alaska. The air temperature was about 60° F.

Later inquiry at Anchorage gave the additional information that a violent shower of thunderstorm type broke upon Anchorage at about this hour. The flat valley lands over which I estimate the funnel to have been when seen are practically uninhabited, so that possible local observers would be few and far between.

The funnel appeared to be attached to, or hanging from, the lower surface of some clouds which would be technically classed as of strato-cumulus type. The base of the parent cloud formation was probably 2,000 feet above the ground, and the funnel, the writer estimated, extended about two thirds of the way to the earth's surface, but at no time during the period observed did it reach the earth's surface.

When first observed, the black-looking funnel was perfectly formed, but before the writer could get a camera and reach a point of vantage for a photograph, the funnel began to disintegrate, and in two or three minutes from the time when first seen, it had entirely disappeared.

W. A. ROCKIE

SOIL CONSERVATION SERVICE,
WASHINGTON, D. C.

A NEW USE FOR THE PSYCHOLOGICAL INDEX[1]

THE Psychological Index, founded in 1894, is a comprehensive bibliography of psychology and related fields. It represents the main approach to the literature prior to 1927. In that year the Psychological Abstracts were founded so that from that time on both abstracts and bibliography are available. Abstracts, however, existed before this, but they were widely scattered and needed to be brought together into one source to become readily available.

This has now been done in the form of the *Abstract References of the Psychological Index.* They cite references to abstracts of 46,000 of the 107,000 titles of the Psychological Index from 1894 to 1928, listing the Psychological Index numbers of the titles for which abstracts have been located with the reference to the journal, volume and page number where the abstracts may be found, so that they will be used in conjunction with the Psychological Index. The Abstract References will in this way open up a new use for the Psychological Index, namely, as a guide to existing abstracts, serving as a backward extension of the Psychological Abstracts.

The publication, which will be available for a nominal amount through the American Psychological Association, will consist of two volumes, one of 180 and the other of 250 pages, the page size of the Psychological Index, produced by a photo-offset process, cardboard bound. The first volume, covering the years 1928 back to 1919, comprising 40 per cent. of the material, is in print; the second volume will be ready shortly.

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QUOTATIONS

THE UNIVERSITY OF CRACOW

THE Polish Ambassador has received from many of the universities in Great Britain expressions of sympathy and indignation at the treatment by the German authorities of the staff of the University of Cracow. The imprisonment and deportation to a German concentration camp of all the professors of this ancient university stands out as one of the most glaring of the acts of violence amid the incessant and general oppression of the people of Poland by Germany.

The following is a brief account of the course of events at Cracow.

The German authorities asked all the members of the teaching staff of the university to attend a conference, at which a German professor was to explain the German attitude towards the Polish scientists. The German lecturer began in the most vulgar manner to slander Polish scholars and Polish science, whereupon the Polish professors indignantly left the lecture-hall. In front of the university a number of heavy lorries were already waiting. All the 160 professors and lecturers were arrested and severely manhandled, in particular the aged Professor Kazimierz Kostanecki, a former president of the Polish Academy of Science; Frederic Zoll, the distinguished jurist; Wladyslaw Konopczynski, the leading Polish historian; Tadeusz Lehr-Splawinski, the noted philologist; and Adam Krzyzanowski, the world-famous economist, who has since died at the hands of the Gestapo.

All the professors, among whom many are septuagenarians, were deported to Germany and interned in a concentration camp. Germany's conduct—aiming not only at the material destruction of Poland by the depopulation of entire provinces, but at the same time at the total extermination of Polish civilization by the removal of the most distinguished representatives of Polish science—has caused condemnation by nearly all British universities.

Among resolutions and expressions of sympathy sent to the Polish Ambassador are the following:

From the council of the Association of University Teachers: "The council of the Association of University Teachers has heard with abhorrence of the arrest and deportation of practically the whole body of professors and lecturers of the University of Cracow by the German invaders of Poland. On behalf of the academic bodies of the universities and university colleges represented in the Association of University Teachers, the council express deep sympathy with their academic colleagues of Cracow University, and the hope that before long they will be restored to their full academic duties and activities on behalf of the liberated Polish nation and of humanity as a whole."

From the Universities Bureau of the British Empire: "The sympathy of the civilized world is with your country in its present great afflictions."

From the Vice-Chancellor of the University of Oxford: "This and the other free universities of the world will not forget, when the day of settlement comes, these crimes against their colleagues of the University of Cracow, and indeed against every center, in the countries which have been invaded, of learning, civilization and truth."

From the Vice-Chancellor of the University of Cambridge: "Our deepest sympathies are with your nation in this time of its suffering."

[1] Assistance in the preparation of these materials was furnished by the personnel of the Works Project Administration for the City of New York, Official Project No. 465–97–3–18, "Bibliographies and Indices of Special Subjects," sub-project "Psychological Index."

From the University of Leeds: "The members of the Senate of the University of Leeds have received with profound indignation the communication of the Polish Ambassador concerning the treatment by the German authorities of the staff of the University of Cracow, and desire to place on record their strong condemnation of an action which can have no military justification and must be regarded as part of a deliberate and wanton attempt to destroy the culture and learning of the Polish peoples. The members of the Senate wish to convey through His Excellency to their Polish colleagues their deep sympathy with them in the loss and suffering inflicted by this brutal outrage which they regard as one committed not only against the University of Cracow but against the whole community of science and learning throughout the world. The members of the Senate are firmly convinced that the University of Cracow will be restored to its former position as a distinguished center of learning able to play a part worthy of its great traditions in the revival of the intellectual and spiritual life of a free and independent Polish nation."

Expressions of sympathy and indignation have also come from the University of St. Andrews; the University of Liverpool; the University of Manchester; University College, Nottingham; the University of Reading; the University of Sheffield; University College, Southampton; the University College of North Wales, Bangor; Queen's University, Belfast; and Glasgow University.—*The London Times.*

SCIENTIFIC BOOKS

A STUDY OF PNEUMONIA

Pneumonia, with Special Reference to Pneumococcus Pneumonia. By RODERICK HEFFRON, M.D. 1,086 pp. New York: The Commonwealth Fund. 1939.

IN 1931 the Massachusetts Department of Public Health inaugurated a study of pneumonia within the state. Ably organized and carried forward, the Massachusetts program has served as an inspiration and model for similar studies not only in many other states and cities of the union but in foreign countries as well. For the five years between 1931 and 1935 the study was financed by the Commonwealth Fund, and since that time the State Department of Health has assumed financial responsibility for carrying the program forward.

The contributions of the Massachusetts study to the knowledge of the disease and its treatment have been considerable, and the plan of organization is not the least of these. Detailed investigations of the epidemiology of pneumococcal pneumonia were made, and facilities afforded for the state-wide typing of cases and administration of antiserum under the supervision of competent advisers.

Another phase of the Massachusetts pneumonia study was devoted to the publication of three books which were designed to record a part of the experience acquired during the operation of the program. All three books have now been published by the Commonwealth Fund and together constitute an invaluable compilation of information concerning the pneumococcus and the disease processes to which this microorganism may give rise.

The first of these volumes, "Lobar Pneumonia and Serum Therapy," by Frederick T. Lord and Roderick Heffron, was published in 1936 and issued in a revised edition two years later. In 1938 Benjamin White's exhaustive treatise, "The Biology of Pneumococcus," which was written in collaboration with Elliott S. Robinson and Laverne A. Barnes, also appeared. Finally, Dr. Heffron, who served as field director of the program, has summarized in the present volume much of the literature pertaining to pneumonia and correlated the observations with those of the Massachusetts study.

Inasmuch as the majority of cases of pneumonia are caused by pneumococci of one or other of the various types, the greater portion of the book is devoted to pneumococcal pneumonia. The disease is treated from the specific etiological point of view as emphasized by Cole, although discussions of the pathogenesis, pathological picture, immunological aspects, epidemiology and clinical course of the disease deal adequately with features common to infections caused by pneumococci in general.

The section of the book concerned with the treatment of pneumonia is very comprehensive, particularly with reference to specific serum therapy, and although Dr. Heffron states in the preface that only certain of the studies published since 1936 are discussed, he has included a short section on chemotherapy which deals with sulfonamide compounds in current use in the treatment of pneumonia.

The extensive bibliography lists over 1,400 titles, and the text is admirably cross-referenced. The numerous tables present the most complete compilation of data referring to lobar pneumonia which has yet appeared.

It may be predicted safely that Dr. Heffron's book will serve for many years as the standard reference work on pneumonia, not only because of the great mass of observations which he has sifted and correlated, but also because of his outlook on the problems which appear still to be far from solution. The most pressing of such problems is that of the prophylaxis of pneumococcal pneumonia. Despite the many advances

which have been made in the past thirty years in the therapy of pneumonia and in the study of the biology of the pneumococcus, the problem of preventing the occurrence of infection has lagged far behind. This question is undoubtedly bound closely to that of the epidemiology of pneumococcal pneumonia, about which so little is known except in the case of localized epidemics, and the findings in such instances do not seem readily applicable to pneumonia as it affects the general population. As Dr. Heffron points out, efforts at the control of pneumonia have been concerned chiefly with therapeutic measures, because procedures designed to prevent the disease have been unsuccessful.

The present volume has been issued at a time when certain of the ideas concerning the treatment of pneumonia are undergoing revision, particularly with reference to the newer sulfonamide preparations which are finding wide-spread use. The publication of Dr. Heffron's book at this time is peculiarly appropriate.

The summary of the data concerning the treatment of pneumonia with specific antiserum and discussion of the theoretical background of this procedure offer a point of view which should not be forgotten in considering newer therapeutic procedures.

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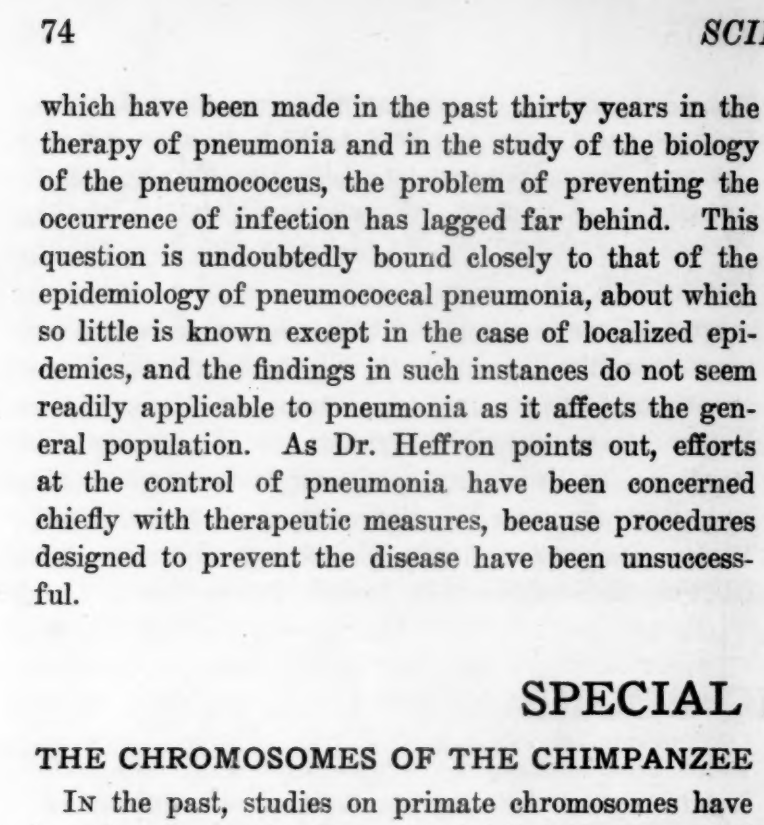
SPECIAL ARTICLES

THE CHROMOSOMES OF THE CHIMPANZEE

IN the past, studies on primate chromosomes have been largely restricted to man, the diploid numbers of only two other species being on record, so far as we are aware. One of these is an unidentified species of brown Cebus monkey from South America which has 54 chromosomes, and the other the common Indian monkey, *Macacus rhesus,* which has 48 chromosomes in both sexes, just as man has (Painter, 1924). Since none of the great apes has been studied, the present note will be of interest, even though our chromosome



FIGS. 1*a*—2*b*

count must be taken as provisional and the material does not allow us to compare the morphology of the chromosomes in this ape with those of man.

The material was obtained at the Yale Laboratories of Primate Biology at the instance of the director, who subsequently very kindly allowed us to study it cytologically at the University of Texas.[1] The testes of two individuals were removed and preserved in three different fixatives (Flemming's, Bouin's and Helly's fluids), but as no attempt was made to separate the spermatogenic tubules other than making slices of the testes, good fixation is restricted to cells lying immediately adjacent to the cut surfaces. The testes of specimen "Don," twenty-two months old, and known to be sexually immature, showed no maturation stages, whereas those of specimen "Al," estimated age nine years, and sexually mature, exhibited all phases of spermatogenesis. Unfortunately, the fixation of metaphase chromosomes proved inadequate, though we have examined hundreds of plates and our counts are restricted to diakinesis stages when the pairs of homologous chromosomes are undergoing contraction to form the tetrads of the first maturation division. At diakinesis the nuclear wall is still intact with the chromosome pairs attached so that in effect the haploid number of chromosome pairs are arranged about the surface of a hollow sphere. This favors a wide separation of the elements, but their extended condition and irregular form—due in part to chiasmata—sometimes makes it difficult to separate elements which lie one above the other along the side walls of the nucleus. We have followed the practice of selecting the most favorable nuclei, then making a careful drawing and, if necessary, making an interpretation of a questionable complex. When all was complete a tally was made of the chromosome number. On this basis we have never found less than 23 nor more than 25 chromosomes, and nuclei which we consider free of ambiguities show 24 chromosomes, which is very probably

[1] Acknowledgment for assistance in connection with this study is gratefully made to Dr. Edgar Allen, Department of Anatomy, Yale School of Medicine, and Dr. James H. Elder.

the true haploid number. This would give a full diploid number for the chimpanzee of 48 chromosomes, the same as for man, the *Macacus rhesus* and the majority of the other mammals which have been studied.

Figs. 1*a* and 1*b* and 2*a* and 2*b* were made from two of the clearest nuclei which we have found so far. The chromosomes seen in the upper and lower focal planes are separated so as to avoid overlapping in the figures. Each of these nuclei shows 24 chromosomes.

The form of the young tetrads has been studied carefully so that the conspicuous types could be recognized and, also, in the hope of identifying the sex chromosome complex. All elements seem to be bivalent in nature, and one bivalent was markedly like the X-Y sex chromosome complex of man. One can not be sure of this identification, however, until maturation divisions are examined.

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CORTIN-LIKE EFFECTS OF STEROID GLYCOSIDES ON POTASSIUM

THE activity of cardiac glycosides is known to be enhanced by calcium, and one might therefore expect these glycosides to be potassium antagonists. Their relationship to potassium in muscle has been recently investigated.[1,2] With this and certain chemical considerations in mind, we tested the effects of digitalin, strophanthin and ouabain[3] on potassium.

A crucial test was the protection of normal animals against lethal amounts of potassium, by previous treatment with a glycoside. This type of experiment was successful with cats, rats and mice. Details of these experiments must await a more complete report, but with death as our criterion, the end point is certain. Zwemer and Truszkowski[4] previously found it possible to protect against potassium poisoning with adrenal cortical hormone.

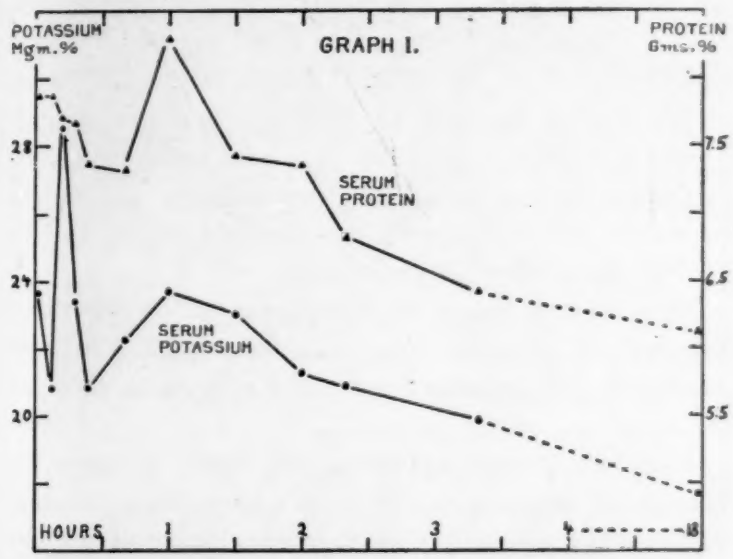
The reverse, protection against glycoside poisoning with potassium, was not satisfactorily demonstrated.

Lowering of the plasma potassium level and blood dilution after glycoside injection is another measure of its activity. The seven curves so far obtained show effects on the plasma potassium similar to those following injection of adrenal cortex extract (Zwemer[5,6]) or desoxycorticosterone esters.[7]

TABLE 1
PROTECTION AGAINST LETHAL KCl WITH STROPHANTHIN[1]

	KCl	Strophanthin	Number of animals	Per cent. survivals
Cats	100 mg/100 g	None	10	0
Rats	150 mg/100 g	None	10	0
Mice	100 mg/100 g	None	32	3.1
Cats	100 mg/100 g	0.015 mg/100 g	6	66.7
Rats	150 mg/100 g	0.200 mg/100 g	29	70.7
Mice	100 mg/100 g	0.150 mg/100 g	126	77.2

[1] Best results were obtained when strophanthin was given 8 to 24 hours before KCl. Protection also has been obtained with digitalin and ouabain.



GRAPH 1. Injection of 0.05 mg of strophanthin per kilogram body weight resulted in an immediate drop in serum potassium followed by a rise to above normal and another decrease. During the first half hour there was a gradual decrease in serum protein. At one hour they both increased, then decreased again and continued to fall for some hours.

The effect of 0.05 mg of strophanthin-in-water per kilogram of cat is given as an example. A significant decrease persisted for at least 18 hours after injection. In previous work we have found that fluctuations frequently appear when one attempts to alter the plasma potassium level. The final low potassium may be due to three factors; blood dilution as shown by the lowered plasma protein content, cell fixation and kidney elimination of potassium.

Prolongation of life in cats deprived of their adrenals (on a diet of salmon and milk with no added salt) is possible with 15 micrograms (.015 mgm) of strophanthin-in-oil per kilogram body weight daily. Withdrawal of material resulted in loss of weight and appetite, followed by death, as is true after withdrawal of corticoadrenal hormone. We realize that the survival of adrenalectomized animals can be accomplished by adjustment of the mineral intake; and with proges-

[1] McK. Cattell and H. Goodell, SCIENCE, 86: 106, 1937.
[2] A. F. Wedd, *Jour. Pharm. Exp. Therap.*, 65: 268, 1939.
[3] We thank the Upjohn Company for a generous supply of these drugs.
[4] R. L. Zwemer and R. Truszkowski, SCIENCE, 83: 558, 1936.
[5] R. L. Zwemer and R. C. Sullivan, *Endocrinology*, 18: 97, 1934.
[6] R. Truszkowski and R. L. Zwemer, *Acta Biol. Exper.*, 12: 1, 1938.
[7] D. Kuhlmann, C. Ragan, J. W. Ferrebee, D. W. Atchley and R. L. Loeb, SCIENCE, 90: 496, 1939.

terone[8] as well as adrenal cortex hormone, but we feel that the minute quantities of glycosides used in the present experiments are noteworthy.

PROTOCOL

Cat ♯Strop 17. Was bilaterally adrenalectomized through a mid-abdominal incision and weighed 3.316 Kg. Daily injections of 0.045 mg of strophanthin in olive oil were given intramuscularly. On the sixth day after operation it was active and weighed 3.402 Kg. As the cat began to lose a little weight by the 9th day, the dose was increased to 0.060 mg for 5 days, then returned to the initial dose. Injections were stopped from the 21st to 28th day and the weight gradually dropped to 3.175 Kg with appearance of typical symptoms of adrenal insufficiency. Attempts to restore the animal with strophanthin failed, and it died 31 days after adrenalectomy.

This cat was prepared for operation by previous injection of strophanthin. Cat ♯Strop 20 similarly prepared, but untreated after the operation, died in 10 days.

It is well known that great care must be taken in the use of cardiac glycosides. We have lost a number of adrenalectomized animals by overdosage at a time when their appetite was good, and when they were gaining weight and were quite active. Overdosage may be due to the absence in the animal body of a specific plant glycoside splitting enzyme (emulsin), which would regulate the concentration of glycoside to aglucone and sugar. Oscillations in the serum potassium level as shown in Graph 1 may also be detrimental, as was pointed out for the rebound after cortin by Truszkowski and Zwemer.[6] Frequent electrocardiograms might serve to indicate the proper dosage.[7,9,10]

We believe that the adrenal cortex hormone may be a glycoside and are at present engaged in isolating glycoside substances from the adrenal glands of cattle and studying their chemical and physiological properties. One of them seems to be a steroid with an ascorbic acid side chain.

Conclusions: Cardiac glycosides have been used to protect normal animals against potassium poisoning; to lower the plasma potassium level; and to prolong life in animals deprived of their adrenal glands. In these respects they resemble the adrenal cortical hormone.

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8 R. Gaunt and H. W. Hays, SCIENCE, 88: 576, 1938.
9 G. E. Hall and R. A. Cleghorn, C.M.A.J., 39: 126, 1938.
10 F. Chamberlain, J. Scudder and R. L. Zwemer, *Am. Heart Jour.*, 18: 458, 1939.

COENZYME CONCENTRATION OF TISSUES

WITH Kohn's method,[1] which measures coenzyme I and II (the V-factor of *H. parainfluenzae*) the concentration of coenzymes in rat tumor was compared with the concentration in normal tissues. Walker 256 carcinoma, kindly supplied by the Biochemical Research Foundation of Philadelphia, was used. The tissues were removed immediately after killing, weighed, ground in a mortar with sand, trichloracetic acid and ferricyanide, the latter to convert the coenzymes to the oxidized form, and centrifuged. An aliquot of the liquid was used in the determinations. Only the outer non-necrotic part of the tumor was used, and histological sections showed that the tumor contained not more than twice the amount of connective tissue present in liver. Tumors ten to thirty-seven days after inoculation were tested. All showed very low values as compared with normal tissue, and there was no variation with age of the tumor. Using a different method, Euler *et al.*[2] have shown low cozymase values in certain tumors. Our results are shown in Table 1.

TABLE 1

Tissue	Number of rats	Av. Coenzyme Conc. γ/gm. wet weight	Variation
Liver	15	542	630–390
Kidney ...	14	510	660–385
Spleen ...	7	568	650–390
Muscle ...	10	522	635–430
Tumor ...	12	71	94–43

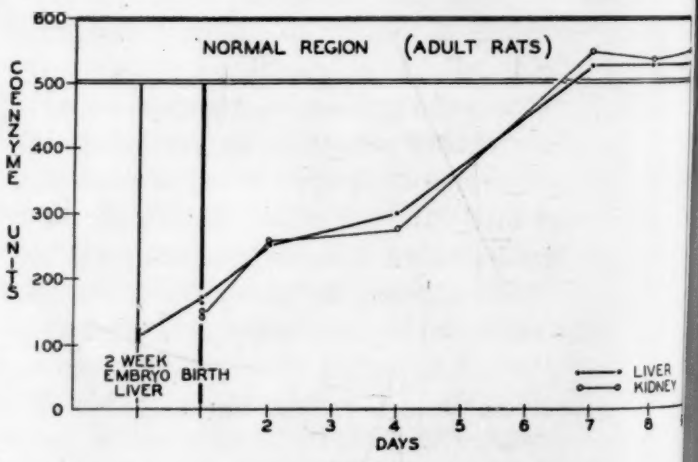

FIG. 1

Fig. 1 shows the coenzyme values of embryo rat liver and of liver and kidney of rats at birth. After birth the values rise rapidly and reach the normal adult range in about a week. This similarity between embryo and tumor tissue may possibly be correlated with the similarities in their metabolism.

Three human carcinomas assayed in the same way showed only traces of coenzymes present.

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1 H. I. Kohn, *Biochem. Jour.*, 32: 2075, 1938.
2 H. v. Euler *et al.*, *Zeits. Physiol. Chem.*, 256: 20[illegible] 1938.

PARTICULATE COMPONENTS OF NORMAL AND TUMOR CELLS

PREVIOUS work in this laboratory has shown that a material, composed of small granules of uniform chemical constitution, could be isolated from both normal and tumor extracts by differential centrifugation at high speed.[1] The procedure adopted for the concentration and purification of these tissue fractions consisted essentially in a series of three to four alternate long and short runs in a high-speed centrifuge under a field of about 18,000 times gravity.[2]

If it is assumed that particles of all sizes are originally represented in the tissue extracts, it can be calculated that the above method will bring about the concentration of those particles ranging in size between 50 and 200 mμ in diameter (approximate density =1.3). Of these, the larger particles are discarded at a much greater rate than the smaller ones during the short centrifugal runs so that the purified tissue fractions may be composed of a population of granules of various sizes, the largest being approximately three to four times the size of the smallest, with a predominance of particles with a diameter of 50 to 150 mμ. In dark-field illumination, the material prepared from various sorts of tissues appears to be composed of granules of nearly the same size. On the other hand, lack of homogeneity as regards particle size is apparent from the spreading of the boundary when the material prepared from both chicken tumor I and chick embryo is examined in the analytical centrifuge.[3]

The present note deals with a comparative study of material prepared, by the centrifugation technique, from chick embryo, mouse embryo, chicken tumor I, a spontaneous mouse tumor, and a transplantable sarcoma originally induced in a pure line of mice by the subcutaneous injection of benzpyrene. The material isolated from these various sources is strikingly similar and the purified fractions obtained from mouse embryo or mouse tumors have been found to possess many of the physical and chemical characteristics already described for the homologous fractions previously obtained from chick embryo and chicken tumor I.[4] Therefore, the properties of these different purified fractions can be discussed together.

No appreciable differences have been found in the solubility of the materials. The purified substance forms opalescent solutions at pH 7. In slightly acid solutions, a point of minimum solubility is found near pH 3.5, whereas the normal opalescence of the solution is appreciably decreased in solutions more alkaline than pH 11. The material is not precipitated from neutral solutions by heating or by 80 per cent. alcohol. The purified tissue fraction possesses a strong absorbing power for ultra-violet light, a maximum of absorption being found at or near λ2,600.

A marked similarity was found to exist, likewise, in the chemical constitution of the granules, irrespective of the tissues from which they were extracted. Chemical analysis shows them to be composed essentially of two main portions, one lipoid, the other protein in nature. A detailed study of these two major constituents of the purified tissue fraction has been made on previous occasions.[5] The lipoid fraction is found to be represented mainly by phospholipids, and to exhibit the properties of aldehydes, as shown by a strongly positive test with the fuchsin-sulfurous acid solution of Schiff.[6] The protein fraction appears to be represented chiefly by a nucleoprotein of the ribose type.[7]

In the present study, a pentose nucleic acid has been prepared from the protein portion derived from chick embyro, mouse embryo and mouse tumors, by following the procedure adopted previously with respect to chicken tumor material.[8] The nucleic acid obtained from any of these sources has been found to represent

[1] A. Claude, *Jour. Exp. Med.*, 66: 59, 1937; *Am. Jour. Cancer*, 30: 742, 1937; SCIENCE, 87: 467, 1938; *Proc. Soc. Exp. Biol. Med.*, 39: 398, 1938; SCIENCE, 90: 213, 1939.

[2] *Ibid.*

[3] K. G. Stern and F. Duran-Reynals, SCIENCE, 89: 609, 1939; A. Rothen and A. Claude, unpublished experiments.

[4] See footnote 1.

[5] *Ibid.*

[6] These lipoid components correspond probably to the group of acetalphosphatides recently described by R. Feulgen and Th. Bersin, *Z. Physiol. Chem.*, 260: 217, 1939.

[7] See footnote 1.

[8] A. Claude, SCIENCE, 90: 213, 1939.

TABLE I

CHEMICAL COMPOSITION OF THE PURIFIED MATERIAL (COMPLETE) ISOLATED BY DIFFERENTIAL CENTRIFUGATION

Source of material	N	P	C	H	Ash (total)	Ash (less P)	Lipoids (total)	Amount purified fraction in tissues (dryweight)
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Chick Embryo	8.22	2.10	59.54	8.65	6.36	1.53	51.0	12.4
Chicken Tumor I.....	8.60	1.54	59.96	8.99	6.00	2.46	36.5	2.9
Mouse Embryo	8.54	2.07	54.63	8.47	7.42	2.66	46.0	9.1
Mouse Sarcoma No. 180 (spontaneous)	8.00	1.52	56.34	8.90	5.32	1.83	49.1	6.6
Mouse Sarcoma No. 1549 (induced)	9.26	1.88	53.56	8.07	8.06	3.74	42.4	7.2

about 15 to 17 per cent. of the protein portion of the purified fraction.

Tables I and II give the results of chemical analysis of the purified fractions before and after extraction

TABLE II

CHEMICAL COMPOSITION OF THE PURIFIED MATERIAL (LIPOID-FREE) ISOLATED BY DIFFERENTIAL CENTRIFUGATION

Source of material	N	P	C	H	Ash (total)	Ash (less P)
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Chick Embryo	13.80	1.21	49.92	7.02	4.07	1.27
Chicken Tumor I ..	12.74	1.16	48.52	7.29	5.94	3.24
Mouse Embryo ...	14.30	1.37	....	...	4.82	1.67
Mouse Sarcoma No. 180 (spontaneous)	14.51	1.21	49.32	6.84	4.23	1.45
Mouse Sarcoma No. 1549 (induced) ..	14.90	1.23	49.77	6.70	4.51	1.68

with organic solvents. In the present experiments, the purified material was found to represent 3 to 7 per cent. of the tumor tissues and as much as 9 to 12 per cent. of the combined tissues derived from the whole mouse and chick embryos.

The above observations indicate that particulate elements, present in normal and tumor tissues, have the general constitution of a phospholipid-ribonucleoprotein complex. The occurrence, in tissue extracts, of a complex of definite chemical composition raises the question whether or not these elements may preexist in the form of similar bodies in the protoplasm. That the structure of cellular components may persist through the process of purification is suggested by the fact that the preparation of the purified fraction is accomplished by purely mechanical means, and that the method was precisely devised with the view of preserving, as much as possible, the integrity of certain active elements of the cell.

The formed elements of the cell which, by their mass, represent an important part of the cellular body, are the nucleus, the Golgi apparatus and the chondriome. The fact that the purified materials appear to contain ribose nucleic acid only is taken to indicate that the particles are not fragments of the nucleus. Furthermore, the nuclei are usually discarded by the first centrifugation at low speed.[9] As regards the Golgi apparatus, it has been shown that the substance of this cellular component has a relatively low density and that it moves toward the centripetal pole when the tissue is submitted to high-speed centrifugation.[10] On the other hand, a review of the general properties of mitochondria indicates that these elements possess many important features in common with the constituents of the purified fractions.[11] According to Cowdry,[12] the breadth of mitochondria may vary, in different localities, from 50 to 200 mμ in diameter. Particles of this size are those which would be concentrated by our method of differential centrifugation at high speed.

The assumption that the granular elements of the purified tissue fraction may represent isolated mitochondria or fragments of mitochondria is also supported by the chemical nature of the material. It is now generally admitted that mitochondria are complex elements made in large part of phospholipids and proteins.[13,14] The occurrence together of nucleoproteins and of certain phospholipids, highly soluble in alcohol and presenting the properties of aldehydes, might explain the response of mitochondria to certain histological dyes and fixatives.[15] There is strong evidence that mitochondria play an important part in the differentiation of the cell.[16] The demonstration that the material isolated from normal and tumor tissues represents, in fact, part of the chondriome and the fact that at least one of these fractions possesses tumor-producing activity[17] should lead to interesting developments in the study of the chemical nature of mitochondria and their possible role in the evolution of the malignant cell.

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[9] R. R. Bensley and N. L. Hoerr, *Anat. Rec.*, 60: 251 and 449, 1934; also personal observations.

[10] H. W. Beams and R. L. King, *Anat. Rec.*, 59: 363, 1934.

[11] The literature on mitochondria is summarized in the monograph of Cowdry (footnote 12) and in that, more recent, of Guilliermond (footnote 14).

[12] E. V. Cowdry, Carnegie Institution of Washington, *Contrib. Embryol.*, 8: 39, 1918.

[13] *Ibid.*

[14] A. Guilliermond, "Les constituants morphologiques du cytoplasme," Hermann et Cie, Paris, 1934.

[15] Bensley and Hoerr (footnote 9) and Bensley (footnote 18) found that mitochondria preparations contained as much as 43 per cent. lipoids, but concluded that the predominating fats were glycerides, not phospholipins. They drew no conclusions regarding the nature of the proteins found in the preparations.

[16] F. Meves, *Arch. Mikr. Anat.*, 72: 816, 1908.

[17] See footnote 1.

[18] R. R. Bensley, *Anat. Rec.*, 69: 341, 1937.

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